ANNUAL RECORD

OF

SCIENCE AND INDUSTRY

FOR 1874.

EDITED BY

SPENCER F. BAIRD,

WITH THE ASSISTANCE OF EMINENT MEN OF SCIENCE.

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PREFACE.

In presenting to the public the fourth volume of the series of the "Annual Record of Science and Industry," some remarks may be fitly introduced in explanation of the aim and scope of the work.

In each of the successive numbers already published new features have been introduced, suggested by experience as well as by the advice of the scientific collaborators and friends of the editor. These are exemplified in part by the increasing number of communications and criticisms on progress in the various branches of science, and by the greater extent of the historical résumés given under the caption of "General Summary of Progress." These have increased in the successive years from 16 pages for 1871, to 50 pages for 1872, and 114 pages for 1873. At the same time, the volumes have successively increased in the number of pages from 634 in 1871, to 651 in 1872, and 714 in 1873.

The editor has been pleased to notice that his endeavors thus to increase the value of the work have been on the whole cordially appreciated by the public at large. With much of praise, however, sundry friendly suggestions for modifications and improvements have been made which merit attention. It has been urged, on the one hand, that some discoveries and memoirs deserving of attention have not been referred to; on the other, that the preliminary Summaries of Progress would be sufficient alone, without any paragraphs recording individual discoveries. It would of course be impossible to satisfy such discrepant opinions, and in this dilemma the only resource left to the editor has been to follow a mean which he hopes will be regarded by most as a tolerably happy one. It must be remembered

that far more than ten times the space contained in the present volume would be necessary to give even an approximately complete abstract of the progress of science in each of the departments embraced within the scope of this work; much more than that amount will in fact be employed in the annual reports that are hereafter to be made and published on the progress of the several departments of science for the past year. These reports, however—unlike the present volume—will not appear till at least one and in some cases two or three years have elapsed from the year in question. These too are, to a certain extent, addressed rather to experts and special students in the various branches of science than to the general reader, for whom the "Annual Record" is more especially designed. In them the several branches embraced herein are respectively reported upon in volumes varying from little less than five hundred pages to nearly two thousand each year. Each special department of science has now its own organ for the record of discoveries within its domain. All these are extremely useful to the investigator, and enable him to economize precious time that would otherwise be spent in frequent references to numerous volumes, some of which are almost or quite inaccessible to all save a favored few. Several are also very elaborate, and the special subdivisions within a single branch are reported upon by experts in the respective subdivisions. Excellent examples of such reports are found in the *Jahresberichte* and *Jahrbücher*, published in Germany, on the mathematical,[1] physical,[2] and chemical[3] sciences, the titles of some of which are

[1] Jahrbuch über die Fortschritte der Mathematik im Verein mit anderen Mathematikern herausgegeben von Carl Ohrtmann, Felix Müller, und Albert Wangerin. Berlin: Druck und Verlag von Georg Reimer. . . . [8vo].

[2] Die Fortschritte der Physik im Jahre . . . Dargestellt von der Physikalischen Gesellschaft zu Berlin. . . . Jahrgang. Redigirt von Dr. B. Schwalbe. Berlin: Druck und Verlag von Georg Reimer. . . . [8vo].

[3] Jahresbericht über die Fortschritte der reinen, pharmaceutischen und technischen Chemie, Physik, Mineralogie und Geologie. Bericht über die Fortschritte der Chemie und verwandter Theile anderer Wissenschaften. Für . . . Giessen. J. Rickers'che Buchhandlung. . . . [8vo].

With a second title-page, viz.: Jahresbericht über die Fortschritte der

given in the foot-notes. Some branches have even two or more annual works devoted to the record of progress in their several spheres; such are especially Zoology,[4] on which one report is published in Germany and another in England; Botany,[5] which has one in Holland and another in Germany; while for Anatomy[6] there are two in Germany alone. To reports like these must the student refer who desires to obtain information respecting the more technical or special facts or generalizations that have been announced. The present volume can administer to their needs only to a slight extent. The editor simply hopes and believes that by the relations which he has established with a number of the most eminent cultivators of the different departments of science in this country, and through their co-operation, he has been enabled to present as complete and reliable a résumé of discovery as can reasonably be expected within

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Chemie und verwandter Theile anderer Wissenschaften. Unter Mitwirkung von A. Laubenheimer, Al. Naumann, F. Nies, F. Rose herausgegeben von Adolph Strecker. Für . . . Giessen. J. Rickers'che Buchhandlung. . . .

Jahresbericht über die Leistungen der chemischen Technologie für das Jahr 1873. Herausgegeben von Rudolf Wagner. Leipzig, O. Wigand. 1874 [8vo].

[4] Archiv für Naturgeschichte. Gegründet von A. F. A. Wiegmann, fortgesetzt von W. F. Erichson. In Verbindung mit Prof. Dr. Leuckart in Leipzig herausgegeben von Dr. F. H. Troschel, Professor an der Friedrich-Wilhelms-Universität zu Bonn. . . . Jahrgang. Zweiter Band. Berlin, Nicolaische Verlags Buchhandlung. . . . [8vo].

Zoological (The) Record for 1872, being volume ninth of the Record of Zoological Literature. Edited by Alfred Newton, M.A., F.R.S. London: John Van Voorst. 1874 [8vo].

[5] Repertorium annuum literaturæ botanicæ periodicæ curavit J. A. van Bemmelen. Tom. I. 1872. Harlemi.

Botanischer Jahresbericht. Systematisch geordnetes Repertorium der botanischer Literatur aller Länder. Herausgegeben von Dr. Leopold Just, Professor am Polytechnikum in Carlsruhe. Erster Jahrgang. Band I. Berlin. 1874 [8vo].

[6] Bericht über die Fortschritte der Anatomie und Physiologie im Jahre . . . Herausgegeben von J. Henle, G. Meissner, und H. Grenacher. Leipzig, C. F. Winter. . . . [8vo].

Jahresbericht über die Leistungen und Fortschritte in der Anatomie und Physiologie. Unter Mitwirkung zahlreicher Gelehrten herausgegeben von Rudolf Virchow und Aug. Hirsch. Unter Special-Redaktion von Professors D. D. E. Gurlt und A. Hirsch. Berlin: Hirschwald. [8vo].

the limited space to which an annual like the present must be restricted.*

As now presented, the "Record" has two distinctive parts: (1) the historical summaries of progress during the past year; and (2) the paragraphs communicating in brief the results of investigations by special scientists or respecting certain subjects. The advantages of the paragraph method, so generally in vogue in analogous publications in the English and other languages, are combined with the more consecutive and eliminating characteristics of the historical; the latter is a much more prominent feature in the present volume than in any of its predecessors, and special attention will be devoted to it in future.

A list of some of the more prominent publications on scientific subjects which have appeared during the past year is added in this volume for the first time; the determination to introduce it was, however, carried into execution too late to render it as complete or critical as could be desired. The labor attendant on the preparation of such a list is very inadequately represented by its length, and the co-operation of the book fraternity is necessary for its thoroughness. It is proposed to make the Bibliography of succeeding volumes an instructive guide for the selection of works, and the views of the collaborators of the editor will be accordingly invoked for the appreciation of their merits.

SPENCER F. BAIRD.

SMITHSONIAN INSTITUTION, WASHINGTON, *February* 10, 1875.

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* Among those who have taken part in the preparation of the historical Summaries, or of abstracts of articles belonging to their respective specialties, or who have supplied early reports of their own original researches, may be mentioned: Professors Simon Newcomb, Cleveland Abbe, Edward S. Holden, Theodore Gill, and O. T. Mason, of Washington; Professors G. F. Barker, E. D. Cope, and Dr. William Wahl, of Philadelphia; Professor C. F. Himes, of Carlisle, Pa.; Dr. Charles Rau, of New York; Professor A. M. Mayer, of Hoboken; Professor A. E. Verrill and Dr. E. S. Dana, of New Haven; Professor W. O. Atwater, of Middletown, Conn.; Dr. T. Sterry Hunt, of Boston; Dr. A. S. Packard, Jr., of Salem; Dr. W. G. Farlow and Mr. Sereno Watson, of Cambridge; Professor Hamilton L. Smith, of Geneva, N.Y.; Professor F. W. Clarke, of Cincinnati; Mr. A. W. Bennett, of London, and other gentlemen who prefer to remain unnamed for the present.

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* In the arrangement of articles in the body of the *Record*, it was found impracticable to place them in proper systematic sequence, especially as many belonged as much to one division as to another, sometimes even to three or four equally. The present systematic Table is intended to remedy the difficulty, by bringing together in proper order all the titles of articles, and, by a system of cross references and duplications, to point out all matter relating to any one subject, whatever be its situation in the volume. The references in Roman letters preceding the page references of the headings relate to the pages of the introductory "Summary."

GENERAL SUMMARY

OF

SCIENTIFIC AND INDUSTRIAL PROGRESS DURING THE YEAR 1874.

MATHEMATICS.

In pure Mathematics we note the completion of the computations of the tables of elliptic functions compiled at the expense of the British Association, and the presentation to the Royal Astronomical Society of an original computation by John Thompson of the logarithms, to twelve places of decimals, of all numbers up to 120,000.

Mr. G. W. Hill offers a valuable suggestion in reference to the use of the true anomaly in the computation of absolute perturbations. The publication of Todhunter's "History of Mathematical Theories of Attraction" is an event eminently worthy of being noticed in this place. A well-considered article in the *North American Review*, from the pen of Professor Newcomb, lays bare the difficulties against which the cultivators of pure mathematics and exact science have to contend in this country, and will, it is to be hoped, stimulate our national progress in that field. An interesting application of pure mathematics to the problems of organic life is that of Dr. Grabau on the spirals of the shells of the Ammonite; he shows that, if we allow for very slight errors of measurement, it will be seen to be impossible to decide whether these animals build their shells according to the concho-spiral or the logarithmic-spiral theories.

A new mathematical society has been formed at Prague.

A mathematical journal, *The Analyst*, has been published during the year by Professor Hendricks, of Des Moines, Iowa, which has contained interesting articles by Professor A. Hall, G. W. Hill, and other mathematicians. This is the only journal in the United States devoted to exact science.

The invention by Peaucellier of what he called his com-

pound compasses has afforded Sylvester occasion to show that the problem of perfect parallel motion has at length been solved, and the ingenious device of the French engineer has enabled him to resolve several curious problems in geometry.

ASTRONOMY.

The Transit of Venus.—The Astronomical forces of the world have continued to a great extent to be engaged in the preparations for the observation of the transit of Venus on the 8th of December, 1874, some details of which were given in our last *Annual Record*, in so far as they had been a year ago decided upon. In accordance with the general plan proposed, the members of all the American parties met at the Washington Observatory in the months of May and June last for practice. Every instrument was set up precisely as it is to be used in the actual observation, and the parties were drilled in all the operations necessary at the stations. Photographs of the sun were taken with the apparatus prepared by the commission, in the same way that they would be taken during the critical hours of the transit. An artificial representation of two sections of the solar disk was set up about a thousand yards from the observatory, and over this an artificial black planet was made to move by clock-work. The apparent magnitude of this planet was the same as that of Venus on the day of the transit, and, by watching it with their telescopes, the observers familiarized themselves with the aspect which Venus would present as she entered upon the sun.

The instruments for the five Southern stations left Washington for New York on May 30, and at the latter port were shipped on board the United States ship *Swatara*, Captain Ralph Chandler, which had been detailed to carry the parties to their several stations. Captain Chandler sailed on June 7, and, after a very fine passage, reached the Cape of Good Hope on August 5. Stopping here ten days for supplies, he sailed for the first station, which was Crozet Island. Here, however, it was found impossible to effect a landing, owing to the absence of a harbor, and the constant stormy weather which prevailed during the time the ship could remain there. So far as known, all the other parties were successfully landed, the stations being in Kerguelen Land, Tas-

mania, New Zealand, and Chatham Island. The Crozet party stationed themselves in Campbelltown, Tasmania.

At the moment of writing this, only a few weeks prior to this interesting astronomical event, the various parties sent out by other nations are already in the field, perfecting those final arrangements on the completeness of which will, to a great extent, depend the success of the observations, unless cloudy weather intervenes. It will, therefore, be proper in this place to give a condensed summary of the observing parties now at the respective stations, as introductory to that account which we hope next year to be able to give of the results of the actual observations:

Nationality.	Number of Stations.	Methods of Observation.	Number of Persons.
United States	8	1 and 3*	30
England	10	1 and 3	45
India	4	....	..
Cape of Good Hope	1	....	..
Australia	2	....	..
France	6	1 and 3	50
Germany	5	1 or 2 or 3	..
Russia	25	1 or 2 or 3	150 (?)
Italy	3	1	..
Holland	1	....	4
Non-official.			
Lord Lindsay	Mauritius	1, 2, and 3	..
Colonel Campbell	Thebes	....	..

* 1, Contacts or Time Durations; 2, Heliometer Measures; 3, Photographic Measures.

The total expenses of all these parties will be not far from one million of dollars, exclusive of the sums necessary for the publication of the results of their labors in zoology, meteorology, etc. The whole constitutes, in fact, a series of great expeditions, having in view the increase of our knowledge of the sections of the world visited by them—expeditions that will continue to bear fruit for many years to come, and certainly long after the approaching transit of 1882. In connection with the preparations for this transit it is important to note that the American, English, and Russian observers have taken especial pains to investigate the errors peculiar to each individual's habit of observation, by practicing upon a mock transit produced by means of suitable machinery.

The solar parallax, as is well known, can be quite accu-

rately determined by observations of an asteroid on each side of the meridian, and Lord Lindsay announces that he will devote his spare time at the island of Mauritius to such observations on the planet Juno.

Among the numerous investigations that have been instituted in connection with the preparations for the transit, is one by Bakhuysen, of Leyden, who maintains that the phenomenon of the black drop is mostly due to diffraction, and has its origin within the telescope. The papers prepared by or for members of the French Commission have been collected in a single and very convenient volume.

Dr. Vogel urges upon the observers of the approaching transit of Venus special attention to the question of the existence of a satellite to that planet, as it may perchance appear on the disk of the sun.

There will be a total eclipse of the sun shortly after the transit of Venus, to observe which Janssen proposes to leave his transit station at Yokohama and proceed to Siam.

Observatories.—The first in importance in America, and we hope eventually in the world, will probably be that endowed by Mr. James Lick, of San Francisco, in a fund amounting to eight hundred thousand dollars in gold, set aside by this gentleman for constructing an observatory in the most suitable spot within the State of California. The administration of this fund is in the hands of trustees chosen by himself, and it is understood that they contemplate the erection of a refracting telescope of the largest attainable size, though possibly the risks of such an experiment may justify them in provisionally mounting a smaller glass at some elevated station.

The 26-inch refractor ordered some years ago by Mr. M'Cormick, of Chicago, from Messrs. Alvan Clark & Sons, is announced to be nearly completed, and awaiting the orders of its purchaser.

The 28-inch mirror of Dr. Henry Draper, at Hastings, is, we understand, being devoted to celestial photography, and that with such success that "admirable photographs of the spectra of stars" are obtained.

The use of the Dudley Observatory, at Albany, has been temporarily transferred to the Army Signal Office, until the appointment of its new director, in which step the trustees

of Union College, Schenectady, now have a controlling voice. We believe that there is now in this country no observatory of any importance, except that at Washington, which is not more or less directly connected with a college or university.

Turning to Foreign Observatories, American astronomers have regretted to learn of the resignation of Dr. Francis Brünnow, Astronomer Royal of Ireland, and director of the observatory at Dunsink, near Dublin. His successor, Professor R. Ball, was formerly assistant to Lord Rosse, and subsequently Professor of Applied Mathematics at Dublin. It will be remembered that Dr. Brünnow was at one time director of the Observatory of Ann Arbor, Mich.

The erection of a monument to the memory of Jeremiah Horrocks has been suggested by Professor Adams, and an appropriate tablet will be placed in Westminster Abbey.

The publication of the Annals of the Paris Observatory, comprising the volumes of memoirs, observations, and charts, has been vigorously entered upon, and Volume X., containing Le Verrier's theory of the mutual actions of Jupiter and Saturn, has already appeared. The very instructive works of Andrè and Rayet, on the Observatories and Practical Astronomy of England, America, etc., are well worthy of notice in this place. The Paris Observatory is being equipped with a four-foot reflector, and a very large refractor (probably 29 inches); a magnetic observatory has also been established at a short distance.

The German government, in the development of its new university at Strasburg, has not forgotten to endow it with physical and chemical laboratories and an observatory, which latter, under the directorship of Professor Winnecke, will undoubtedly take a high rank. A refractor of 20-inch aperture has been built for it by Merz & Mahler. The same government has further shown its determination to keep the lead which it has long maintained in astronomical matters by the erection of an observatory at Potsdam devoted especially to the study of the sun. The English government has been repeatedly urged to take a similar step in the interests of meteorology and magnetism as well as of astronomy, and it is not impossible but that it will erect such an establishment at some favorable point in India.

The inconveniences of the site of the Vienna Observatory

have justified the Austrian government in the construction of a new one, which is said to be on the most magnificent scale. A refractor of 30-inch aperture is reported as having been ordered for it; one of 12-inch aperture has already been furnished by Alvan Clark & Sons.

The famous private observatory of Mr. Warren de la Rue, at Cranford, near London, has been given up, and the instruments have been presented to the University of Oxford. A building proper for the reception and use of this apparatus, and constituting a new astronomical observatory devoted to physical astronomy, so called, is being built by the university.

Pogson, at Madras, announces that with increased means at his command, he expects to clear away the large arrears of work that have accumulated at that observatory.

At Quito, the erection of an observatory is announced in connection with the university. Its director, Father Menten, has secured some excellent instruments from Germany.

Astronomical Instruments.—We note under this head that the experience of Professor Newcomb as to the efficiency of the 26-inch Clark refractor at Washington has been exceedingly gratifying, and shows that such mammoth instruments can be used with great success. The new photographic lens of 13 inches' aperture, for the observatory at Cordoba, in the Argentine Confederacy, has been safely received.

Among the instruments auxiliary to the work of an observatory may be noticed the calculating machine, devised by Mr. Grant, of Cambridge, and applicable to the computation of the reduction of star places.

The magnificent private observatory of Lord Lindsay, at Dunecht, furnishes occasionally, through the ingenuity of its possessor, some important improvements in the delicate apparatus of observational astronomy; the machinery for driving his equatorial is said to be so perfect that no deviation whatever from its required movement can be perceived.

It is probable that among the apparatus of every well-furnished observatory there will hereafter be included some instrument for the regulation or the exact measurement of personal errors in time observations; the independent researches of several European astronomers, combined with those of the United States Coast Survey and Naval Observatory, show, in fact, that on the one hand the errors can be

measured, and that on the other hand, by continual regular daily practice in observing artificial transits, astronomers may easily maintain remarkably regular habits of observation, such as it has hitherto been extremely rare to find.

The dissemination of standard time throughout the country by means of the telegraph has continued to attract more and more attention, and it is to be hoped that the day is not far distant when a uniform (Washington?) time may be adopted by all classes of the community, as has for some years been the case in Great Britain. The great advantages that will flow from such uniformity are already beginning to be felt in the various boards of trade and merchants' exchanges, as they have long been felt by all who make frequent use of the telegraph and railroad; it is probable that the rest of the country will speedily follow in the lead of any state or city that would declare itself in favor of a legal uniform standard time throughout the whole country. At the present moment the railroads from New York to Chicago are supplied with Philadelphia time from the Pittsburgh Observatory, the State of New York is supplied with New York time by the Albany Observatory, New England uses Boston time as given by the Cambridge Observatory, the states south of Pennsylvania and many buildings in Washington receive the time from the observatory in that city. At all these places the clocks constructed by Mr. Hamblett, of Boston, are used with perfect satisfaction, and it would be an easy matter to make them all beat to Washington time, without introducing any competition between governmental and individual enterprise, and without altering the present arrangements in accordance with which the clocks are regulated from the centres of their respective districts.

The Sun.—In reference to the sun, Langley, of Pittsburgh, announces that the solar spots are colder than the adjacent photosphere; he has also published remarkably fine drawings of the solar spots, and concludes that we must greatly increase our received estimates of the intensity of the action that takes place on the sun's surface.

Professor Holden has confirmed the results obtained by Wagner as to the existence of an apparent variation in the diameter of the sun depending on the condition of the earth's atmosphere, and subsequently, in connection with Professor

Newcomb, has shown, with a very high degree of probability, that the Greenwich and Washington observations combine to demonstrate the non-existence of any short period in the sun's diameter.

The solar parallax has been determined anew by Galle, from observations of Flora. His preliminary result is 8.86″, or identical with the values that within the past few years have been adopted as the best.

In reference to spectroscopic observations of the sun, Stone, at the Cape of Good Hope, has observed during the recent solar eclipse the reversion of all the principal Fraunhofer lines at the immediate edge of the sun, and on the other hand he saw them distinctly in the spectrum of the corona.

Mr. Ranyard calls attention to the fact that the photographs of the total eclipse of 1871, although taken at different stations, present appearances showing that there was then between the earth and the sun a semi-transparent body, possibly the nucleus of a comet hitherto undiscovered.

Concerning the nature of the solar spots, Messrs. Wilson and Seabroke advance the theory that the sun is a series of strata of liquids, whose densities, boiling-points, and pressures are so adjusted as to be in very unstable equilibrium. Langley finds right and left handed whirls and even vertical currents within the penumbra of a spot. Faye continues to maintain his theory of the depression of solar spots due to downward currents; while Spörer adduces what must be considered as equally good evidence of the existence of currents of rising gases above the spots, which are, he thinks, the hottest portions of the sun's surface. Lohse, carrying out the same theory, concludes that there must exist a very appreciable amount of refraction in the solar atmosphere. Secchi has attempted a new determination of the solar temperature. Professor Airy announces that at Greenwich Observatory photographs of the sun will be made daily, at least until some other institution offers to take up the work.

The Moon.—In connection with the doubt expressed a year ago by the Astronomer Royal as to the accuracy of the lunar tables, we record the announcement by Mr. Lewis, of Mount Vernon, Ohio, that he has undertaken to compute in detail the eclipses recorded in the ancient Chinese annals.

Mr. Neison has shown that the existence of a lunar atmosphere having $\frac{1}{400}$ part of the density of our own will probably explain the discordances that have hitherto been observed between the results of occultations.

Mr. Birt, on behalf of the British amateur astronomers, has published a valuable collection of notes referring to selenography, being extracts from letters received during many years past by the committee of the British Association. Several photographs of special lunar districts enrich the volume.

The great map of the moon on which Professor Schmidt has labored for thirty-seven years is announced as completed, but awaiting the means of publication. The literature relating to the moon has been enriched by the beautiful work of Nasmyth and Carpenter.

The Planets.—In reference to the various members of the planetary system, we note an interesting paper by Lord Rosse on the spots of Jupiter as observed with his six-foot reflector; and on the same subject, although presenting somewhat different conclusions, is the study by Schmidt upon the rotation of Jupiter about its axis as shown by the movements of its spots.

The following list comprises the asteroids discovered up to the first of December, 1874:

No.	Name.	Discoverer.	Date—1874.
135.......	Hertha.......	C. H. F. Peters, at Clinton.	February 18.
136.......	?	.......Palisa, at Pola..................	March 18.
137.......	?	.......Palisa, at Pola..................	April 20.
138.......	?	.......Perrotin, at Toulouse............	May 19.

The fact that but one of these was discovered by an American is explained by the consideration that our own asteroid hunters, Peters and Watson, have both been engaged in matters relating to the transit of Venus, and have, in fact, been absent from their observatories since last May.

Five new comets have been discovered up to December 1st, as given in the following list:

No.	Discoverer.	Date—1874.
I..........	Winnecke, at Strasburg...........	February 20.
II..........	Winnecke, at Strasburg...........	April 11.
III..........	Coggia, at Marseilles.............	April 17.
IV..........	Borelli, at Marseilles..............	July 28.
V..........	Coggia, at Marseilles.............	August 19.

Of these, No. III. was the only bright one, and was, indeed, the brightest of all that have visited the solar system since 1861; further details concerning it will be given below in a subsequent section.

Notwithstanding the unfavorable weather of the early spring, Professor Newcomb has been able to secure with the Washington refractor a very complete series of observations of the four satellites of Uranus, the total number of determinations of position exceeding that of all previous astronomers combined. The satellites of Neptune have also been carefully observed with this instrument. The reflecting power of Mercury has been investigated by Zollner, by means of his elegant photometer. Messrs. Vogel, Lohse, and Klein adduce arguments supporting the view that there may exist a satellite to the planet Venus.

As the accuracy of all astronomical deductions depends more or less upon the perfect regularity of the diurnal rotation of the earth, special importance attaches to the conclusion of Professor Newcomb that certain irregularities may exist in that motion, affording us the most probable explanation of phenomena observed in connection with the motions of both our own and Jupiter's moons.

The Zodiacal Light.—The zodiacal light has been the subject of very careful observation by Wright, of Yale College, who concludes from the polarization of its light that it must be a ring of small bodies attending the sun: a view that is also compatible with the theories of Jones, Alexander, and others, while Groneman goes still further, and argues very plausibly that the aurora, the zodiacal light, and the meteoric bodies have this in common, namely, that they are one and all portions of that cosmical dust that pervades all the solar system, and is rendered visible by either the reflected light of the sun, the heat produced by friction, or by electric discharges.

Comets.—Among the numerous investigations called out by the appearance of Coggia's comet, we note briefly the careful observations of the extent of its tail by Heis and Abbe, the elaborate theory of the structure, nature, and origin of the tail by Faye, who seems, however, merely to have elaborated the views relative to a repulsive force presented by Professor Peirce, and by G. W. Bond in his incomparable

work on Donati's comet; the spectroscopic observations by Rayet, Lockyer, Secchi, Huggins, and others, and the polariscopic observations of Wright, Zenker, and Secchi; from all of which it may be concluded that the nucleus was a glowing solid or liquid, unless, as some think, it may have been rather a condensed group of clashing meteorites. The tail was evidently illuminated to a considerable extent by the solar rays; concerning its chemical constitution, nothing definite can be concluded, since the evidence is quite conflicting as to the existence therein of any true gas. The appearance of envelopes was recorded by Huggins and Lockyer, the latter of whom observed, with the great telescope of Mr. Newall, four faint envelopes successively rising from the nucleus. Weber searched for, but found no satisfactory proof of the rotation of either tail or nucleus about an axis.

In 1861 the spectroscope was in its infancy, and had not been generally applied to celestial objects. It does not seem that any one thought of examining the great comet of that year with such an instrument. The comet of 1874 is therefore of great interest as the first bright one to be observed with the spectroscope. Unfortunately its position during the period when it was brightest was quite unfavorable, being so near the sun that it could be seen only when very near the horizon. For this reason perhaps the result was disappointing, nothing remarkable being discovered in the spectrum. The latter was found to comprise, first, a faint continuous spectrum, probably produced by reflected sunlight, and, second, three bright bands. The latter have been seen in all comets hitherto examined with the spectroscope, and therefore form no new feature. They have always been found to coincide with the spectrum of carbon, and, from this circumstance, the theory that comets consist of some sort of carbonic vapor may be considered as strengthened by the observations in question.

Meteoroids.—Shooting-stars form the subject of a valuable report to the British Association by Mr. Glaisher and Mr. Gregg, the latter of whom has computed a number of cases in which there is an agreement between the orbits of meteors and comets. At the Toulouse Observatory an extraordinary passage of corpuscles across the sun's disk was observed on the 5th, 6th, and 7th of September.

Galle has investigated very thoroughly the path of an interesting meteor, of which numerous valuable observations were available; his development of the formulæ for the computations is especially thorough.

The Fixed Stars.—In reference to the fixed stars we note the series of determination of stellar parallaxes by Dr. Brünnow, and the investigation by Nyrèn into the nutation of the earth's axis, from which, as a side issue, it results that great doubt must still attach to all absolute determinations of the distances of the stars.

Mr. W. A. Rogers calculates that the movements of the star Eta Draconis are so irregular as to indicate the probable existence of a disturbing companion.

Otto Struve announces that continued observations of the companion of Procyon, discovered by him a year ago (but as yet seen by no one else, and whose existence is even doubted by some), show that it is the disturbing body predicted by Bessel and Auwers.

Professor Main, of Oxford, has nearly brought to completion the great posthumous work of Sir John Herschel, namely, the catalogue of double stars. A similar, but far greater work, including ten thousand double stars, has been completed by Mr. Burnham, of Chicago, who has during the year discovered over one hundred new double stars.

In regard to the scintillation of the stars, Montigny concludes that the frequency of variations in colors depends on the constitution of their light; he also confirms the statement of Dufour that the red stars scintillate less than the white.

Baxendell announces the detection of a new variable red star; while D'Arrest contributes still further to our knowledge of this subject by investigating the peculiarities of the spectra of the variable stars in general.

As regards the question of the arrangement and general constitution of the universe, several important papers have been published. D'Arrest announces that he is at work examining the spectra of all the stars belonging to the Milky Way, and that he has come upon some stars whose light is of a very remarkable character. Dr. B. A. Gould, as one of the results of his survey of the Southern heavens, shows that, besides the Milky Way or belt of faint stars, there also exists a zone of bright stars, inclined about 25° to the former; this

fact seems to have been alluded to by Sir John Herschel, but it was reserved for Dr. Gould to trace the bright zone with tolerable distinctness through the entire heavens. After allowing for the influence of this zone, Dr. Gould finds that the distribution of all stars down to the ninth magnitude is quite closely represented by the assumption that the stars are very uniformly distributed through space, and are on the average of the same order of intrinsic brilliancy.

The Nebulæ.—Huggins has attempted to apply to the nebulæ that class of spectroscopic observations by means of which he was able a few years ago to measure the velocity with which the stars approach to or recede from the earth. Notwithstanding the extreme difficulty of the work, he concludes that none of the nebulæ show a motion relative to the earth of more than twenty-five miles per second, and that, as a class, the proper motions of the gaseous nebulæ are not so great as those of the fixed stars. Mr. Abbe states that if we consider the nebulæ which are recorded as "very much extended," or as "mere rays of light," to be very flat spheroids or rings or planes, then their axes of rotation lie in or near a common plane inclined to that of the Milky Way by about twenty-five degrees.

PHYSICS OF THE GLOBE.

Terrestrial Magnetism.—Sir William Thomson, in urging upon telegraphers the importance of observing the existence of spontaneous currents upon lines of telegraph, states that if the line be worked with a condenser at each end such observations can be made without disturbing its use for business purposes. The same savant concludes that, on account of the disturbances produced by the rolling of the vessel, it may be necessary at sea to use very long compass-needles.

The first annual report has been received from the new magnetic observatory of the Jesuit College at Zi-ka-wei, near Shanghae.

Forssman has published a very thorough memoir on the connection between the aurora borealis and magnetic phenomena, and the winds and barometer.

An important publication has been that of Mühry "On the Geographical Distribution of Atmospheric Electricity," from which it is seen that the latter has its origin in the heated

surfaces of the earth, the atmosphere being electrified by induction; the consequence deduced by him that no electrical development should be perceptible in the polar regions is a fact attested by all arctic explorers.

Among the more noteworthy auroras of America we record those of February 4th, April 7th, and October 3d and 4th; and Mr. Abbe calls attention to the fact that in a vast majority of cases the region over which an aurora is visible is bounded on the east, south, and west by a region within which lightning is simultaneously occurring.

To the general catalogues of auroras another has been added by Fritz, who has also contributed a remarkably accurate chart of auroral frequency, with which he has coupled some suggestions; while Groneman has developed very fully his own theory as to the cosmical origin of the aurora.

Seismology.—The year has been signalized by the occurrence of several important earthquakes, of which we may mention the following:

In North Carolina, sixty slight shocks from February to April.

Violent shocks at Antigua on September 3d; and in Sicily, September 27.

Strong shocks in Constantinople, June 26; Utah, June 18; Malta, October 18; Ceylon, September 19; Vera Cruz, Nov. 13.

Notable volcanic eruptions occurred August 10–20 in Japan; September 1, etc., Mount Etna; April 30, Society Islands.

Mallet has published a continuation of his seismic investigations, and deduces an approximate determination of the rate of contraction of the earth's radius, namely, 3.5 inches in 5000 years; and has, in an interesting note on the volcano of Stromboli, given a detailed explanation of its mechanism, and a refutation of the idea that its eruptions depend upon atmospheric changes.

La Faulx and Kortum have given a somewhat minute examination of the phenomena of the German earthquake of October 22, 1873.

Schmick has investigated the changes in the level of the Caspian and Aral basin in the light of the theory of the secular variations in the sea-level and the tropic zones; a more general note on this subject is published by Mr. Hind, of Nova Scotia.

Mr. Clingman has given, in the New York *Times*, July

10 (?) an interesting review of the earthquake phenomena that have been noticed in Western North Carolina during the past hundred years.

Strictures upon Mallet's theories have been published by Hilgard, Dutton, and others in America, as well as by several English physicists.

The changes of level in the neighborhood of the Great Salt Lake have interested Professor Joseph Henry, at whose request Dr. Parke, of the Deseret University, has erected a monument for the purpose of making standard measurements.

Angus Ross, of Halifax, offers the following generalization: "That the mountain chains of the earth are arranged in parallel lines along certain belts or zones, which girdle the earth in great circles, each having for its medial axis a line of volcanoes."

The earthquakes of the Caucasus form the subject of a communication from Moritz.

Temperature of the Earth.—The subject of earth temperatures has been considered by Schenzl, who finds, from eight years' observations at Ofen, that twenty-one days are required by the temperature to penetrate to a depth of three feet. Everett's report to the British Association contains some statistics on this subject.

Ocean Currents.—Attention has been called by Dr. Carpenter to the fact that many of the most important laws with reference to the ocean currents that have during the past ten years been developed by English physicists were anticipated over forty years ago by Lenz, the Russian physicist, who accompanied Kotzebue in his voyage around the world. According to Lenz's theory and observations, the coldest waters are at the bottom of the ocean where the current is always flowing from either pole to the equator, the surface currents being in the opposite directions, except in so far as they are modified by the winds. In this connection, we again mention the very valuable wind and current charts published by the British Admiralty, as well as the charts of ocean temperature compiled by Cornelissen, and published by the Dutch Meteorological Office.

The researches carried on by the *Challenger* expedition, so far as published, are an earnest of the invaluable results to

be expected when the whole of that great work becomes known.

The equally interesting and thorough work done by the United States steamer *Tuscarora* throws a flood of light upon the condition, hitherto unknown, of the currents, temperature, and depth of the northern half of the Pacific Ocean.

The return of the North Polar exploring expeditions has also contributed in the hands of Petermann to important corrections and confirmations of our views of those regions, so that it would seem that the general circulation of the ocean is now fairly understood; the theoretical views, however, as advanced by Carpenter, Colding, Croll, Ferrel, and others, are still somewhat at variance; those of Schilling seem to us wholly inadmissible.

Of the systems of observation at fixed stations of ocean temperatures, those of the Army Signal-office and the Scottish Meteorological Society are apparently the most extensive. The results of the latter are presented in very interesting annual reports in connection with sea-fisheries. Some of the results of the United States system are published in the monthly weather review of the Army Signal-office, and in the annual report of the United States Fish Commissioner.

METEOROLOGY.

In our review of the progress of meteorology, attention must first be given to the steady growth of official or national weather bureaus throughout the world, as shown by the completion of the organization of the Chinese office under the Revenue Department, the reorganization of the French meteorological establishments under the Ministry of Public Instruction, the publication of the *Bulletin du Nord* at Copenhagen, the exhibition of storm-signals in Great Britain, and the very general extension in the activities of all the previously established offices, especially those of the United States, France, Russia, Denmark, the Argentine Confederacy, and India.

The proposed publication by Hoffmeyer of a daily atlas of the weather over the North Atlantic, including Greenland and Europe, and the promise by Le Verrier of the early publication of the delayed volumes of his atlas of the Atlantic, will be welcome to all, and will afford a very important ex-

tension eastward. That ocean meteorology will hereafter receive much more attention than it has during the past ten years is assured by the fact that the German government has taken the important step of elevating the private *Seewarte* of Von Freeden to the rank of a national institution, while Holland, Germany, and Russia have united in the organization of work relating to maritime meteorology; and the meeting held in September at London of the Maritime Conference, called together by the permanent committee of the Vienna Congress, passed such resolutions and recommendations as will contribute decidedly to a unity of action on the part of both naval and merchant services in Europe, and we hope also in America.

In the United States, an important change has been that by which the reports of the voluntary meteorological observers of the Smithsonian Institution, the Patent Office, the Agricultural Department, and official reports of the Surgeon-General's office of the Army, and to a considerable extent those of the Navy, have all been concentrated at the Weather Bureau of the Army Signal-office; as a consequence of which its monthly weather reviews have acquired a greatly increased value, being now based upon nearly five hundred stations. From these weather reviews we gather that, on the average, about twelve storm-centres pass monthly over some portions of the United States.

Of special investigations in this department of science, we notice the great work of Köppen on the remarkable connection between increase or decrease of solar spots and the changes of temperature throughout the earth; the investigation by Mohn into the anomalies in the diminution of temperature with increasing altitude; and the valuable studies of Mühry into the distribution of moisture in the upper strata, showing that a stratum of saturated air exists at a certain altitude over the greater part of the earth.

Weilemann has shown that the protection against radiation of heat from the earth afforded by the average cloudiness of the sky is three times that afforded by the moisture present in clear weather. Fines shows that the radiation during clear nights is less in the city than in the country.

The laws of the movement of storms have been elucidated by Maydell, who has shown their tendency to follow areas

of abnormal warmth. Loomis has shown, among numerous other important details, that they move toward the regions of greatest rain-fall; while Ferrel, in a memoir replete with interest, has deduced, from a purely theoretical point of view, the relation between the winds and gradients of cyclones, and has shown the agreement of his laws with actual observations.

The connection between sun-spots and cyclones has been more minutely examined by Meldrum, according to whom it is beyond all question that the number and violence of the cyclones of the Indian Ocean are far greater in years of maximum than of minimum sun-spots.

Very important maps have been compiled by Cornelissen, showing the frequency of the occurrence of storm-winds for each square degree in the neighborhood of the Cape of Good Hope.

Professor Harkness has given the first results of a memoir prepared for the Smithsonian Institution on the distribution of temperature over the earth.

One of the most important contributions to meteorology consists in the isobares and winds published in the Admiralty Charts of the Atlantic, Pacific, and Indian oceans.

Dove has shown that areas of extreme cold weather require about two days' time to complete their movement westward over the whole of Europe, showing that their motions are similar to the cold areas of America, and that they proceed from the interior of Asia, as do ours from our northwest territories.

The meteorology of the arctic zone has been developed in a series of interesting studies by Mohn, Chavanne, and others, which have appeared as successive chapters of Petermann's contributions to the geography of the polar regions.

Among the notable storms of 1874 we should record the typhoon of March 27–28, at the Mauritius; that of September 23, over Macao, Hong-Kong, and the China seas; that of October 17, in Bengal; that of August 9, at Nagasaki and in the Japan seas; and that of Oct. 30–Nov. 1, in the West Indies. These two latter were of unprecedented violence, and caused great destruction of life and property; fortunately, their paths appear to have been short and narrow.

Among meteorological instruments is especially worthy

of mention the self-registering upsetting thermometer of Negretti & Zambra. Wild, of St. Petersburg, demonstrates that his self-registering balance barometer gives results as accurate as the eye observations of any but the most expert observers. Of general works on meteorology, that of Lorenz and Roth is worthy of mention, since it pays special attention to the connection of agriculture and forestry with meteorology. The investigations of Baranetzky into the periodical flow of sap in trees, as dependent upon atmospheric changes, should be mentioned in this connection.

Of numerous scientific balloon voyages, we can here enumerate only those of King and Holden in the United States, of Tissandier in France, and of Brunelle in Russia. The French Association has, by an especial appropriation of money, stimulated similar voyages.

Helmholtz gives a calculation which does not promise well for aerial voyages to Europe. He shows that in order to give a balloon a velocity of 18½ miles per hour, it would require five per cent. of the power necessary to propel a large ocean steamer 13 miles an hour; but the volume of the balloon would have to be forty-two times the displacement of the steamer.

Symons has begun the publication in *The Colonies* of a monthly weather review for the English dominions. The publication of the "Atlas meteorologique" for France, and of the "Atlas generaux," has been resumed.

PHYSICS.

In *Molecular Science*, Professor F. W. Clarke shows that the specific heats of chemical compounds apparently vary with their boiling-points and temperatures. The researches of Plateau on the phenomena of thin films, and those of Van der Walls on the continuity of gases and liquids, have opened the way for a satisfactory explanation of many molecular phenomena; and Maxwell, commenting on the latter work, takes occasion to demonstrate the highly interesting theorem "that the molecules of gases attract each other at a certain small distance, but repel each other when they are brought still nearer together, as, for instance, when compressed into the liquid state."

Thurston, of Hoboken, announces that the strength of iron

and steel may be increased by alternately straining them up to the limit of elasticity, and then removing the pressure. Similar observations have been made by Commander L. A. Beardslee, United States Navy. Neissen has shown that the elastic reaction of torsion increases with the duration of the experiment.

At the meeting of the National Academy of Sciences, in Philadelphia, Professor Rood described the modifications he had made in the arrangement of Zöllner's horizontal pendulum, which have rendered the instrument fit for use in such physical investigations as require the measurement of very minute changes in dimension. He has thus succeeded in measuring, with the modified apparatus, so small a quantity as twenty billionths of an inch.

Marey continues his beautiful researches in *Animal Mechanics;* and during this year has solved what has heretofore been the most abstruse point in the mechanical theory of flight. He has, in fact, experimentally shown that the resistance opposed to the bird's wings during flight is far greater than the resistance opposed when the bird first rises on the wing to begin its flight; for in the former case the bird's wing always beats a new portion of air which it tends to depress; but, on account of the short duration of the pressure which it receives, any one of these portions of air has not the time to acquire the velocity of the wing; these portions of air are therefore successively compressed, and offer the maximum or initial resistance to the wing. Marey has also made an interesting research on human locomotion, in which he shows that the leg in walking does not, as Weber maintains, swing with pendulous motions, but is animated with nearly uniform motion while the foot is off the ground.

In *Acoustics*, Professor Tyndall has made observations off the coast of England on the transmission of the sounds of fog-horns and cannon through the atmosphere when in different conditions. He is of the opinion that he has established the very interesting and important fact that in clear weather, when the sun causes a rapid evaporation of the water of the ocean, the air is rendered less permeable to sound, by reason of the reflection of the sonorous waves from the surfaces of portions of air differing considerably in their temperatures and in their degrees of hydration. On the

other hand, he maintains that sound is transmitted with great facility through the atmosphere when charged with fog, by reason of the more uniform distribution of heat and moisture in the atmosphere when in this condition.

But the explanation of these phenomena by Professor Tyndall has not generally been accepted by men of science. Thus Professor Henry, the chairman of our own Light-house Board, and Professor Reynolds, of England, are of the opinion that the cause of the feeble intensity of sounds often observed, even when they are transmitted through a clear atmosphere, is owing to the different velocities with which air moves at the ground and at an elevation above it. Hence when the wind moves with the sound it will tilt the sonorous wave-front downward, and the observer on the ground, or near the surface of the sea, will hear the sound more distinctly even than when the air is still; but if the wind move against the sound, then the sound passes over the head of the listener. Professors Henry and Reynolds have independently brought their views to the test of a rigorous course of experiments, and they find that the facts conform to their hypothesis. The reader is referred to accounts of these important researches, contained in the body of this volume.

Professor A. M. Mayer continues his researches in acoustics, and has this year published papers Nos. 5, 6, and 7 of his investigations on this subject. He has brought forward a new theory of the mode of audition in man and mammals, which he arrived at after a minute study of the anatomy of the ear. He is of the opinion that the fibrils of the auditory nerve must vibrate one half as frequently as the membrane of the drum of the ear, or as the basilar membrane which forms the floor on which rests the organ of Corti. His hypothesis is supported by experiment, for he finds, when vibrations of a tuning-fork are sent directly into the inner ear through the bones of the head—and therefore when the nerve fibrils must of necessity vibrate as often as the fork—that the note of the fork rises an octave above what is perceived when the fork vibrates the air outside the ear. This prediction from his hypothesis has been confirmed by some of the best-educated ears.

In another research, Professor Mayer shows by very simple

experiments the reflection of sound from flames and from heated and even cold gases, and he has obtained approximate measures of these reflecting powers. In the same paper he also gives the first determination ever made of the mechanical equivalent of sound. He finds that the aerial vibrations produced during ten seconds by a Ut_3 fork placed in front of its resonator equal in mechanical effect about $\frac{1}{100,000}$ of a Joule's unit; that is, these aerial vibrations can be expressed in the equivalent work done in lifting fifty-four grains one foot high.

The most important research of Professor Mayer is his discovery of a physiological law susceptible of a mathematical expression; this law expresses the connection existing between the pitch of a sound and the time during which its sensation remains in the ear, after the vibrations causing this sound have ceased outside the ear. He finds that the sound of the lowest audible note of forty vibrations per second lasts on the ear $\frac{1}{10}$ of a second, while the highest sound, of forty thousand vibrations per second, remains in the ear only the $\frac{1}{500}$ of a second. The treble C gives a residual sensation of $\frac{1}{50}$ of a second. This law has shed much light on many obscure facts of physiological acoustics, and in its applications has served to render quantitative much of the qualitative work in Helmholtz's "Physiological Theory of Music."

Professor Rood has devised a simple and exceedingly beautiful method of determining the numbers of vibrations of solid bodies, by observing in a telescope the figures produced by vibrations of two fine wires attached to the bodies. These wires cross each other, and by superposition of their motions produce figures of a similar general character to those given in Lissajous' experiments with reflecting forks.

In *Thermotics* we have an important research by Jannattaz, in which he shows that heat is conducted in crystals and in lamellar rocks better in the direction of the planes of cleavage than in directions across these planes. He has also determined the laws for the conduction of heat in crystals, with two or more planes of cleavage.

Professor Crookes, of London, has brought out a most remarkable paper on the action of heat in producing attraction and repulsion between bodies placed in vacuo and in air. He is bold enough to venture the suggestion that in these dis-

coveries may at last be found that "agent acting constantly according to certain laws" which Newton holds to be the cause of gravitation. The observations of Crookes have, on the one hand, called forth a criticism by Reynolds, showing that the evaporation of minute portions of vapor will partially explain them, and, on the other hand, have elicited from Professor Crookes a reply, in which he adduces still further and crucial experiments, maintaining his original propositions.

Professor Tresca has observed, during the forging of the great ingot of platino-iridium, that one could see upon its sides luminous streaks accompanying each blow of the hammer, and he shows that the zone which becomes momentarily luminous in consequence of the blows of the hammer is that along which the molecules flow when the change of form takes place consequent upon the blow.

Fatigati has made a new determination of the mechanical equivalent of heat through the medium of electricity, and his result (464.87 units of work) agrees well with that ordinarily received.

The laws of the explosion of gases within fire-arms have been deduced by Sarran from well-known laws of chemistry and thermo-dynamics. He considers that his results are remarkably confirmed by observations made by the French Naval Artillery Commission. Messrs. Abel and Nobel have published the accurate results of their observations on the explosion of gunpowder. They find the temperature at the moment of explosion to be about 2200° C., and the tension of the confined gases 41.7 tons to the square inch.

In *Optics*, Professor Pickering has made an excellent and very elaborate research on the polarization of the light reflected from the sky and from one or more plates of glass.

The fact that the zodiacal light is polarized in a plane passing through the sun has been first established this year by Professor A. W. Wright. This fact seems to show that the zodiacal light is the sun's light reflected from innumerable small meteoric bodies. Professor Wright found that fifteen per cent. of this light is polarized. He has also made careful examinations of the spectrum of the zodiacal light, and his results conform to the hypothesis above advanced as to the origin of this light.

Observations suggested by Janssen have resulted in showing that the two dark bands in the solar spectrum, on either side of the D line, disappear at the altitude of from 6000 to 7000 meters, reached in a balloon. This shows that these lines are due to the absorptive action of our atmosphere, and not to the action of moisture in the sun's atmosphere, as maintained by Secchi.

Villari has investigated the time required by magnetic currents to rotate the plane of polarization of a ray of light passing through glass.

Becquerel has succeeded, by using chlorophyl after the manner of Dr. Vogel, in obtaining a photograph of the spectrum much longer than that given by plain collodion, and confirming Vogel's statement that plates sensitized with iodide or bromide of silver may, by a proper varnish, be made sensitive to other than the extremely refrangible rays.

In the department of *Spectroscopy*, Professor Eaton, of Philadelphia, proposes a simple modification of the spectroscope, by means of which the dispersion is increased fourfold. The origin of the curvature of the transverse lines of the spectrum has been investigated by Christie, of Greenwich Observatory, and a method of reflection suggested by means of which it may be counteracted. The equally simple method of a curved slit has been practiced by some English makers. Lockyer has continued his spectroscopic studies bearing on the chemical constitution of bodies including the so-called simple elements; and somewhat more attention has been given than hitherto to the very important modifications of the spectrum depending on the temperature of the radiating and absorbing bodies.

Croullebois describes an ingenious arrangement by means of which he is able to determine exactly the ellipticity of the vibrations of homogeneous elliptically polarized light.

As a simple camera, for convenience in drawing, Govi proposes to use a plate of glass covered with a thin film of gold or silver, a device that has been already in use in this country and France.

It is announced that a method has been devised, we presume at the works of Messrs. Chance & Co., by means of which perfectly achromatic objectives can be constructed of a lens of the terborate of lead, combined with others formed

of a phosphatic glass containing a suitable percentage of titanic acid. Cornu explains a mode of constructing for astronomical photography a lens whose focal length shall be the same for both chemical and visual rays. His method differs but little from that originally used by Rutherford, but subsequently improved upon by him.

Hirn and others, from observations on the reflection of sunlight from a sheet of flame, show that probably the glowing solid particles that give the flame its brightness are themselves at the same time nearly transparent. The interesting researches of Wiedemann into the superficial colors of bodies have shown that the problem depends on the connection between absorption and elliptic polarization.

The introduction of diffraction gratings, instead of prisms, in spectroscopic research continually extends; and, according to the experiments of Rayleigh, these fine-ruled plates may be reproduced by the photographic process of contact printing. He has also published a well-timed essay on the theory of the action of gratings, which leaves nothing to be desired.

Mr. J. M. Blake has applied a very ingenious method of testing the accuracy of diffraction gratings by superposing the lines of the gratings, and observing the appearances produced by the crossing of these lines. In these positions the lines produce effects similar to those observed when we view one picket-fence through another.

In *Electricity*, Professor Mayer has quite recently succeeded in analyzing the composite phenomenon of the electric discharge, by passing the flashes of various electric discharges through rapidly revolving disks of thin paper coated with the smoke of burning camphor. By these simple means he has arrived at the most remarkable results, especially in the case of a large induction coil, whose discharge, when a small Leyden jar is in its circuit, he finds to consist of between 90 and 100 distinct flashes, gradually closing up on each other in the middle of the discharge, where they succeed each other at each $\frac{1}{10,000}$ of a second, and again separating toward the end of the discharge.

The formation of the American Electrical Society (of which Anson Stager is president) will, we hope, stimulate original research as well as "practical" work in this field. Messrs.

Schrauf and Dana have investigated the curious electrical properties exhibited by some crystallized minerals when they are gently heated. Edlund's theory of the physical nature of electricity is supported by Emsmann and others, according to whom electricity, galvanism, and magnetism are but manifestations of the workings of that same æther that suffices to explain the phenomena of light and heat. Mr. Thayer has studied the action of condensers made with solid dielectrics. The chemical influences of the galvanic current have been studied by Brodie and the Messrs. Thenaud, who have observed interesting cases of synthesis. Bolzmann, with reference to dielectric absorption, shows that the molecules of electrized bodies are themselves polarized, thus confirming in a striking manner the opinions of Faraday. Similarly, Streintz shows that a current of electricity passing through a wire expands it lengthwise more than is due to its heat, as though the molecules were polarized; and Gore adopts a similar view with reference to magnetism, which is, he thinks, an attribute of every substance whose molecules admit of a certain special arrangement. On the other hand, Cazin has shown that if opposing galvanic currents surround a bar so that an attempt is made to give opposite magnetisms to the same portion thereof, there is only an evolution of heat. The committee of the British Association recommend, on the score of simplicity, the general adoption of the centimeter, the gramme, and the second, as the three fundamental units in electricity and magnetism.

Of the applications of electricity, the most valuable in a practical way is the perfection being attained in the Stearns duplex system of telegraphy. A quadruple system has even been shown to be possible. The remarkable performances of Mr. Little's automatic system, which is now in daily operation between New York and Washington and other cities, gives us a glimpse of the wonderful future of electric telegraphy.

CHEMISTRY.

The progress in *General Chemistry* has been very marked, the opinion that inorganic molecules have a much more complex constitution than organic having constantly gained ground. Of course this greater complexity must be of the

nature of polymerism; and it can not be definitely settled until some method is devised for determining the molecular weight of non-volatile compounds. An important step in this direction has been taken by F. W. Clarke, who has shown that the molecular volume of chemically combined water is variable, while that of crystal-water, or molecularly united water, is invariable. The researches of Berthelot upon *Thermochemistry*, actively continued during 1874, will no doubt conduct finally to the same desirable end.

In *Inorganic Chemistry*, Troost and Hautefeuille have shown that palladium forms a definite compound with 600 volumes of hydrogen, Pd_2H, and that then this may itself dissolve additional hydrogen. They have also prepared the compounds Na_2H and K_2H, and have observed that both lithium and thallium have a feeble occluding power for hydrogen. They calculate the density of hydrogenium in the solid form as 0.63. Böttger, following in the same line, describes some interesting experiments with the palladium alloy, and shows that hydrogen is absorbed likewise by nickel, cobalt, and tin. F. Wöhler states, too, that palladious oxide, produced from the nitrate by ignition, is reduced by hydrogen even in the cold, with incandescence. Tribe calls attention to the curious property of agglomerating finely divided metals possessed by hydrogen.

Mermet proposes the action of hydrochloric acid upon chloride of lime in the cold as a ready means of obtaining chlorine. The chloride is placed in a self-regulating apparatus, like that used for hydrogen or carbonic acid. A. Naumann has discovered the important fact that in metameric organic bodies containing oxygen, of the same chemical character and similar in structure, the boiling-point is lower the nearer this oxygen approaches the middle of the atomic chain. Schrötter has analyzed a cosmetic for turning the hair to a golden color, and finds it to be a dilute solution of hydrogen peroxide, containing about six times its volume of oxygen.

Kingzett has thoroughly investigated the alleged production of ozone by the oxidation of essential oils in sunlight, and has shown that neither ozone nor peroxide of hydrogen is formed, but that the activity of the oil is due to a peculiar compound, probably hydrate of terpene oxide. Schöne shows (1) that a loss of one-quarter part of ozone takes place when

this gas is collected over water; (2) that this loss—which is the greater the longer the two are in contact—is not due either to an absorption of the ozone by the water, or to an oxidation of the latter to hydrogen peroxide; (3) that contact with water converts ozone into ordinary oxygen; and (4) that this conversion is accompanied by an expansion of volume, the increase being the same with that calculated from the absorption of ozone by potassium iodide. He also asserts that ozone is capable, in presence of water, of oxidizing nitrogen. Carius, in a later research, while confirming essentially Schöne's results, denies that nitrogen is directly oxidized by ozone, although he found nitric acid in water into which ozonized air had been passed. He was not able to determine accurately the absorption co-efficient of ozone in water, though he states that approximately water dissolves its own volume of ozone.

Gernez has made the curious observation that from a supersaturated solution of sulphur in benzol either prismatic or octahedral crystals may be caused to separate, even at the same temperature, simply by introducing a crystal of the form desired. Indeed, if excess of the octahedral form be left in the tube, that form on cooling will crystallize in contact with the solid mass, while the other form may be obtained out of the same solution at the same time by the introduction of a prismatic crystal. Michaelis and Wagner have thrown some light on the constitution of sulphurous acid and sulphites—and therefore indirectly upon the equivalence of sulphur in this form of combination—by showing that this acid has not the constitution ascribed to it by Strecker, viz., $H.SO_2.OH$, but that it is $HO.SO.OH$. In the former formula the hydrogen atoms have unlike positions, and two isomers are possible, except where both are replaced by the same radical. Only two bodies of the composition $(C_2H_5)_2SO_3$ are known: one, produced by acting on ethyl sulphon-chloride with sodium ethylate, must have the composition $C_2H_5.SO_2.OC_2H_5$; the other, the ordinary ethyl-sulphite, must necessarily have the formula $C_2H_5O.SO.OC_2H_5$. Hence sulphur is a tetrad in the sulphites. Boussingault, in an elaborate paper on the acid waters of the Cordilleras, gives analyses of the water of the Rio Vinagre, which contains 0.057 gramme of free sulphuric acid in one litre, and of that

of the Ruiz thermal spring, which contains 3.664 grammes of pure sulphuric acid in one litre. As the former river delivers 34,785 cubic meters of water daily, it follows that it carries to the sea every day 46,873 kilogrammes of sulphuric and 42,150 kilogrammes of hydrochloric acid; and every year seventeen millions of kilogrammes of the former and fifteen millions of kilogrammes of the latter. He believes that the simultaneous presence of chlorides and sulphates in the rock explains the production of hydrochloric, of sulphurous, and, under certain conditions of temperature, of sulphuric acid in the emanations from the volcanic craters and fumerolles; and accounts consequently for the occurrence of these acids free in the thermal springs of the equatorial Cordilleras. Rammelsberg has succeeded in establishing the isomorphism of selenium and sulphur. He finds that a mixture of one atom of selenium to four atoms of sulphur takes the form of the latter. The noteworthy fact, in regard to selenium, that its electrical resistance is enormously diminished by the action of light, the least resistance being observed in the extreme red rays—a phenomenon first observed by Lieutenant Sale, R. E.—has been confirmed by the Earl of Rosse, who obtained in some cases a diminution of 38 per cent. This decrease is approximately as the square root of the luminous intensity.

Carius, as the result of his investigations, concludes that, in nature, nitrification takes place, (A) from free nitrogen by (1) electrical discharges in the air, and (2) by oxidation in the air of other bodies; and (B) from the oxidation of ammonia (1) by electrical discharges, (2) by the presence of the so-called alkaline substances, and (3) by ozone. Berthelot suggests the preparation of nitric oxide (the anhydrous nitric acid of some chemists) by the action of phosphoric oxide upon the strong nitric acid. The process goes on quietly, the nitric oxide crystallizing in large crystals on the walls of the receiver. The same industrious chemist has investigated the heat of formation of the oxides of nitrogen; with reference to nitrogen dioxide, he says: "Such an aptitude for slow and multiple decompositions characterizes compounds which are but imperfectly stable, and which are formed with absorption of heat. Nitrogen dioxide, in this respect, is comparable to cyanogen and acetylene; all these compounds possess an aptitude for entering into chemical combination, a sort of

chemical plasticity, much superior to that of their elements, and comparable to that of the most active radicals; a curious fact, to be explained by the excess of energy imprisoned in the act of their synthesis. In the act of combination in general the energy of the elements diminishes; but in the formation of acetylene, of cyanogen, and of nitrogen dioxide, on the contrary, this energy increases." Berthelot has also succeeded in preparing ammonium nitrite in the solid form. It is a white crystalline mass, tenacious and deliquescent. Heated or percussed, it detonates with violence. Troost and Hautefeuille, in studying the conversion of ordinary into red phosphorus, have shown that two different tensions of phosphorus vapor exist, one of which corresponds to the ordinary phenomenon of vaporization, the other to that of its transformation into the allotropic condition. This latter, which the authors call the tension of transformation, has always a constant value at the same temperature. Ritter has shown that the black variety of phosphorus discovered by Thenard is not a third allotropic modification, but is the result of the presence of some impurity, especially arsenic, as he thinks. Blondlot, on the other hand, could not produce black phosphorus with the aid of arsenic, though a trace of mercury gave it very readily. As, however, Thenard's variety, when oxidized, gave no precipitate with hydrogen sulphide, Blondlot suggests that its color may be due to a mixture of red phosphorus.

Laspeyres describes some large, well-defined crystals of metallic antimony—some of which were eight millimeters on a face—obtained from a cavity in the slag of a metallurgical establishment using antimonious lead ores. The terminal interfacial angles of the rhombohedrons were 87° 7½′ to 87° 13′, the lateral 92° 52′. These were mixed with some very curious twin crystals. Apjohn has discovered the presence of vanadium in a meteoric stone which fell at Adare, Ireland, in 1810, and which is now in the Mineralogical Museum of Trinity College, Dublin. Gernez obtains octahedral borax from strongly sursaturated solutions, whether these be obtained by ebullition or by spontaneous evaporation in the cold. But if the solution be touched with a crystal of prismatic borax, the excess of borax crystallizes in prisms. Both forms then can be obtained at the same temperature;

the point of 56°, ordinarily given as the inferior limit for the production of the octahedral form, is really only a temperature near the superior limit at which the prismatic form appears, the latter losing a part of its water at this temperature. Basarow has investigated the compound of fluorine, oxygen, boron, and hydrogen discovered by Gay Lussac and Thenard in 1809, and called by them fluoxyboric acid, and has shown that it has no separate existence, being only a solution of boric acid in hydrofluoboric acid. Subsequently the same conclusion was reached for the salts.

Melsens has succeeded in utilizing the absorptive power of charcoal for gases for the purpose of liquefying them. Fragments of recently calcined wood-charcoal are introduced into the long leg of a Faraday tube; this is surrounded with ice, and saturated with the gas to be liquefied. It is then hermetically sealed, the longer leg is heated in a water-bath, the shorter being in a freezing mixture. In this way sulphurous oxide, chlorine, ethyl chloride, cyanogen, hydrogen sulphide, ammonia, and hydrocyanic acid are liquefied with ease. Moreover, he has observed that this charcoal, thus saturated with a gas, exhibits marked active properties. Saturated with chlorine, it burns hydrogen to hydrochloric acid even in the dark, producing a *lowering* of the temperature. Water in vapor is decomposed when passed over this chlorine-saturated charcoal, cold and in the dark, producing hydrochloric and carbonic gases. Liquids when used to moisten charcoal cause a considerable rise of temperature; in the case of bromine, using 11 grammes of carbon and 97 of bromine, the elevation of temperature is 30° C. From this heat the calculated force of attraction of the liquid for the solid surface is 893 atmospheres for water, 3080 for alcohol, 4620 for ether, 13,090 for carbon disulphide, and 23,190 for bromine. Bloohmann has made an exhaustive research on the products of the incomplete combustion of coal gas, and on the effects of heat upon coal gas. Godeffroy proposes antimonous chloride as a test for caesium. In not too dilute solutions of caesium, acidified with hydrochloric acid, it throws down a white crystalline precipitate. This, dissolved in dilute hydrochloric acid, and evaporated, yields well-formed hexagonal crystals permanent in the air. Crookes, the discoverer of thallium, has published an extended paper on this metal, giving its modes of occurrence, the methods of

its preparation, its properties, and those of many of its compounds. Heumann proposes, for the preparation of pure cuprous chloride, the action of hydrochloric acid upon an intimate mixture of copper oxide and zinc-dust; the acid to be poured when saturated into previously boiled water. The cuprous chloride separates as a snow-white crystalline powder.

Henri Morin has analyzed a series of Chinese and Japanese bronzes sent to the Paris Exposition, and noted for the beauty of their patina. He finds them remarkable chiefly for containing lead, the first group having as high as twenty per cent. even; the second group contained zinc in addition. The beauty of the patina hence results from the composition of these alloys, and the author has been able to obtain the same patina on imitation alloys made synthetically. Chandler Roberts has given an account of the processes employed by him to obtain accurate standard trial plates for verifying the coinage at the British Mint, both gold and silver. Wolcott Gibbs has published a most elaborate memoir upon the hexatomic compounds of cobalt, in which he describes a new octamine base, which he calls Croceocobalt, together with a number of new salts of this and the other cobalt bases. But the point of greatest interest in the research is the discovery of a series of metameric bodies among these cobaltamines—the first observation of true metamerism in inorganic chemistry. This summary would be incomplete without a mention of the remarkable casting of a 250-kilogramme ingot of platinum-iridium for the new standards of the International Metric Commission; of the extended research of Abel, of the English War Department, on explosives; and of Berthelot on refrigerating mixtures and their action.

The department of *Organic Chemistry* not only has more workers, but is at present a more extended field. Blochmann has proposed to determine acetylene from the copper contained in the acetylide, produced by passing the gaseous mixture through ammoniacal cuprous chloride. In ten litres of coal gas, for example, he found from 0.063 to 0.064 per cent. of acetylene. In the gases from a Bunsen burner, burning at the base of the tube, he found twelve times this quantity. P. and A. Thenard have exhibited to the French Academy a tube containing acetylene solidified by the silent electric dis-

charge. According to Berthelot, the solid body is polymerized acetylene. C. R. A. Wright has continued his researches upon the isomeric hydrocarbons of the terpene series, and has made considerable progress toward determining the nature of their isomerism. Riban has also been working industriously in this direction, and with success. Groves has suggested a ready method of preparing ethyl chloride, by dissolving zinc chloride in twice its weight of alcohol, and passing a current of hydrochloric acid into the solution at a boiling temperature. The chlorides of the other alcohol radicals may be prepared similarly. Hofmann has continued his researches into the constitution of essential oils. He has proved that the oil of *Cochlearia officinalis*, the so-called scurvy-grass, is the iso-sulphocyanate of secondary butyl alcohol; the oil of *Tropæolum majus*, the common nasturtium, the nitrile of α-toluic (phenyl-acetic) acid; the oil of *Nasturtium officinale*, the ordinary water-cress, is the nitrile of phenyl-propionic acid, and a homologue of the former; the oil of *Lepidium sativum*, the cultivated pepper-grass, the nitrile of phenyl-acetic acid, and identical with that of *Tropæolum majus.* Gladstone and Tribe have studied the action of their copper-zinc couple—being granulated or laminated zinc upon which copper has been deposited by immersion in a dilute solution of copper sulphate—upon the bromides and iodides of some of the alcohol radicals and the olefines, both alone and in presence of water and alcohol.

An exhaustive paper has appeared, by Victor Meyer, upon the nitro-compounds of the fatty series. These bodies are isomeric with the corresponding nitrous ethers—nitro-ethane $C_2H_5-NO_2$ being isomeric with ethyl nitrite C_2H_5-O-NO—but are distinguished from them by the fact that, like the nitro-derivatives of the aromatic series, they are capable of reduction to amines—nitro-ethane, for example, becoming ethylamine $C_2H_5-NH_2$. Ladenburg has added many more substances to the list of those interesting organic compounds in which silicon replaces carbon. He has described the methyl ether of silico-propionic acid, prepared by the action of zinc ethyl upon methyl orthosilicate, silico-acetic acid, prepared analogously, the chloride of silico-phenyl, ethyl-ortho-silico-benzoate, and meta-silico-benzoate, meta-silico-benzoic oxide, silico-phenyl-triethyl, the chloride of silico-tolyl and sil-

ico-toluic acid. Demole has given a ready and rapid method for the preparation of glycol, by distilling together a molecule of dry potassium acetate, a molecule of ethylene bromide, and an equal weight of eighty per cent. alcohol, on the water-bath, with an upward condenser, for sixteen to eighteen hours. The yield is twelve per cent. of the bromide employed.

Schulze has confirmed O'Sullivan's observations upon maltose, the form of sugar produced when malt acts upon starch. It is a compound sugar, possesses two thirds the reducing power of dextrose, rotates the polarized ray three times as much, and on boiling with dilute acids takes up a molecule of water and splits into two molecules of dextrose. Nägeli has called attention to a fact which he claims to have proved, that the various kinds of starch differ in the proportions of two different modifications of this substance which they contain. One of these modifications is turned blue, the other yellow, by iodine. By boiling with water, starch gives a solution which on concentration deposits crystalline masses, turned yellow by iodine, and which the author calls amylodextrin, whose rotatory power is to the right, and intermediate between starch and dextrin. Vignon has published an elaborate paper upon mannite, in which he shows: (1) that mannite possesses in solution the power of affecting the molecules of certain inactive bodies, such as boric acid and its salts, forming with them dissymmetrical molecular groupings, but retaining for itself the power of acting on polarized light; (2) that in this way, and in such solutions, the rotatory power of mannite can be determined when associated with water in certain proportions; (3) that sulphuric acid, heated with mannite to 120°, transforms it into mannitan by simple dehydration; (4) that by the action of water in sealed tubes upon mannite, two new bodies, mannityl oxide, or ether, and mannitone, an isomer of mannitan, are produced. In the same paper the author describes nitro-mannitan, a new nitro-derivative. Bondonneau has investigated the character of dextrin, the best mode of preparing it, and its reactions. He finds that commercial dextrin contains dextrose, to which is due its power of reducing the copper test. To prepare pure dextrin, he destroys this dextrose by the copper test, and then precipitates the dextrin by alcohol. Thus prepared, dextrin is colored dark red by iodine, is not

reduced by the copper test, or colored by caustic alkalies, but is abundantly precipitated by barium hydrate. In a subsequent paper he shows that dextrin is changed into dextrose at a high temperature in presence of an inert but moist gas, and that the transformation is increased by the presence of minute quantities of acid. Gautier has succeeded in effecting a remarkable synthesis likely to lead to important practical results. By withdrawing a molecule of water from two molecules of a glucose or simple sugar, one molecule of a compound sugar is produced by the union of the residues. The production of the valuable cane sugar from the cheap and abundant starch sugar, or from this and some other variety of simple sugar, is to be looked for in this direction; could it be accomplished, the industry of sugar would be revolutionized. The step which Gautier has taken is to solder together two molecules of dextrose by the action of hydrochloric-acid gas upon it dissolved in alcohol, and thus to produce a compound isomeric, but not identical with saccharose. It is not a sugar, is deliquescent, not precipitable by ammoniacal lead acetate, reduces difficultly the copper test, and is dextrogyrate.

Schorlemmer and Dale have shown that suberone, produced by the dry distillation of suberic acid, is the acetone of this acid, and yields an acid isomeric with pimelic acid, on oxidation, called α-pimelic acid. Kekulé has published a paper on the constitution of camphor, giving it a rational formula analogous to an acetone, and taking well into account the numerous reactions of which it is capable. This chemist, undoubtedly the most eminent in Europe, having been called to Munich as the successor of Liebig, is remarkable for the power of prediction which he possesses, and which he has introduced into the science—the oxycymene, described in the paper in question, having been foreseen by theory before it was realized as fact. Neison has studied the products of decomposition of castor-oil, and has shown that sodium ricinoleate yields by dry distillation methyl-hexyl-ketone, unless an excess of alkali is present, in which case heptyl aldehyde is produced. Hell and Lauber have effected an easy synthesis of crotonic acid by acting upon mono-bromobutyric acid with alcoholic potash. Steiner has succeeded in forming succinic acid artificially by the ac-

tion of silver-dust upon bromacetic acid, a molecular condensation taking place. Erlenmeyer and Sigel have formed a true nitrile of leucic acid by the union of hydrocyanic acid and amyl-aldehyde; and from the nitrile they have obtained the acid by simple oxidation. The mode of this synthesis determines the true constitution of leucic acid. Pinner has announced the discovery of a lactic acid belonging to the allyl series, formed by boiling ethyl mono-chloracrylate with barium hydrate. Kolbe has made the synthesis of salicylic acid a commercial success. His method is to heat sodium-phenol—prepared by evaporating to dryness a saturated solution of phenol in caustic soda—first to 100°, then to 180°, and finally to 220°-250°, a stream of dry carbonic gas being passed continuously through the apparatus. A curious fact observed at this time was that, while calcium and barium hydrates also readily yield the salicylic acid, potassium hydrate thus treated yields an isomer of it—para-oxybenzoic acid. Some experiments, made for the purpose, proved the remarkable antiseptic power of salicylic acid.

Hofmann has examined the noticeable body discovered by Liebermann in the crude wood-vinegar from beech-wood, and termed by him *cœrulignon.* The crude substance was the last product of the distillation of beech-wood tar, and when treated with caustic soda solidified to a brown crystalline mass. After purification, a colorless oil was obtained, which gave on oxidation with chromic acid violet crystals agreeing in all respects with cœrulignon. Tiemann and Haarmann have succeeded in producing the active principle of the vanilla bean—vanillin—from a substance of entirely different origin, viz., coniferin. The coniferin is extracted from the cambium sap of several varieties of the pine-tree, and forms groups of white needles in crystallizing. By the action of a ferment emulsin, coniferin is split into dextrose, and a second product which on oxidation with potassium dichromate and sulphuric acid yields vanillin. Steps have been taken to utilize this discovery commercially. Fischer has investigated further the remarkable body discovered by Baeyer, and called fluorescein. It is prepared by heating together two molecules of resorcin and one of phthalic oxide to 200°; and is obtained as a crystalline red powder, non-volatile and quite insoluble. It is especially characterized by the magnificent

green fluorescence of its solution in ammonia. Several of its compounds are described. Perkin, to whom many of the coal-tar colors owe their discovery, has added a modification of alizarin to the list. Bromalizarin, produced by replacing an atom of hydrogen in alizarin by bromine, crystallizes in orange or brownish-orange crystals, which are capable of dyeing with mordants like alizarin; but the shades of color are not exactly the same, the reds being less purple, and the purple less blue than those produced with alizarin.

Lange has described a polymer of hydrocyanic acid, having the composition $H_3C_3N_3$. It is formed by the action in sealed tubes of hydrocyanic acid (anhydrous) upon epichlorhydrin, and crystallizes in garnet-red prisms. Hofmann has observed the important fact that by the action of heat the position of certain definite groupings within the molecule may be changed, thus producing isomers. In the secondary base, ethyl-aniline (ethyl-phenylamine), $C_6H_5.C_2H_5.H.N$, for example, on heating to 300° or 330° for twelve to eighteen hours, the ethyl group shifts its position, and now replaces a hydrogen atom in the phenyl group instead of a typical hydrogen atom; thus producing phenethylamine $(C_6H_4.C_2H_5)H.H.N$. isomeric with the former, but a primary instead of a secondary base. It is believed that this action is quite general. Hugo Schiff obtained last year, by dehydrating the base butyraldine, a liquid alkaloid having the composition of conicine, the active principle of *conium maculatum*. He has subsequently more fully investigated the relation of the artificial to the natural alkaloid, and has shown that they are true isomers; and that while natural conicine is a secondary base containing an atom of typical hydrogen, the artificial base, which he terms para-conicine, is tertiary. He has obtained a new and condensed base also, which he names para-di-conicine. C. R. A. Wright has continued his valuable researches on the opium alkaloids, particularly to codeine—with its derivatives apocodeine, tricodeine, and tetracodeine—and narceine. Important practical results therapeutically may be expected to flow from these investigations. Delitsch and Volhard have simultaneously discovered a new method for the synthesis of guanidine, by heating ammonium sulphocyanate to a temperature of 180°–185° for twenty hours. Grimaux has effected the synthesis of the uric-acid deriva-

tive oxalyl-urea (parabanic acid). Considering this body as acid oxalate of urea minus two molecules of water, and oxaluric acid as the same salt less one such molecule, it seemed easy to produce the former from the latter. Oxaluric acid heated to 200° with phosphoryl chloride yielded a substance in crystals having when purified all the properties of oxalylurea. The author proposes to drop the term parabanic acid.

In *Physiological Chemistry* the progress of the past year has been notable. Terreil has analyzed the bones of the fossil human skeleton found by M. Rivière at Mentone. The phalanx of the foot yielded: phosphate of calcium, 56.76; carbonate of calcium, 25.00; water, 11.68; nitrogenous organic matter, 4.07; phosphate of magnesium, 1.71; ferric oxide, 0.06; silica traces; total, 99.28. The spongy, internal mass of the calcaneum yielded: calcium carbonate, 64.33; calcium phosphate, 17.12; silica and ferruginous clay, 8.31; water, 6.37; organic nitrogenous matter, 2.40; magnesium phosphate, 0.60; total, 99.22.

Wibel has criticised Aeby's conclusions as to the existence in bones of a polybasic phosphate. He shows that when bone phosphate is ignited, the carbonic acid which it loses is not resupplied to it on subsequent treatment with ammonium carbonate. These results he explains by the supposition that under these conditions a slightly basic phosphate is formed. He is therefore of opinion that the mineral constituents of bones are tricalcic phosphate and calcium carbonate. Weiske and Wildt have experimented upon the effect produced on the bones of young animals by feeding them on food deficient either in phosphoric acid or lime. Lambs under these circumstances decreased in weight and became diseased. Their bones weighed less than normal bones, but they contained the normal quantity of phosphoric acid and lime. Weiske himself has studied the effect of madder when mixed with the food in coloring the bones. Rabbits from six weeks to six months old, being fed with bran mixed with five per cent. of powdered madder, showed the reddening first at the point of ossification of the intermediate cartilage of the femur, after three days. After 28 days' cessation of the madder the color had but slightly diminished. The cartilage left on treating the colored bones with hydrochloric acid was colored, but the calcium phosphate precipitated from the so-

lution was not, showing that the color is fixed by the organic matter of the bones.

Müller has examined the respiration of frogs, and finds (1) that the direction of a series of observations is constant; (2) that the brown frog consumes more oxygen than the green frog; (3) that they both consume less when hungry; (4) that they consume the same amount in the winter time when under water; (5) that on being released, after being frozen in ice eight hours, they breathed at the normal rate. He also observed that, weight for weight, a mouse consumed twenty-four times as much oxygen as a frog.

Forster has made a series of experiments on the importance of the inorganic constituents of food. He divides the salts of the food into two classes: those which are firmly combined with combustible substances, and are indispensable ingredients of the juices and blood; and those which are simply dissolved in the juices. The latter greatly preponderate, being either introduced from without or produced within the body. The former class can not leave the organism when in combination, nor even when dissolved in the juices. Experiment shows that although the salts are to a great extent retained and used over, a certain amount is excreted. Hence, when salts are withheld, the whole body, but especially those parts actively changing, like blood and muscle, become gradually poorer in salts and richer in albumin; but, though the total quantity in the body is lessened, the mixture of salts in the tissues and juices is unchanged. The diminution of salts in the muscles causes muscular exhaustion; and in the nerves, first excitability, and then paralysis of the nerve-centres. The quantity of salts necessary in food is less than has hitherto been supposed.

Heitzmann has shown that the administration of lactic acid to cats and dogs, either by the stomach or hypodermically, causes, within two weeks, swelling of the epiphyses of the long bones, catarrh, and other symptoms of rachitis; a result confirmed by microscopical examination of the bones. Continued for four months, the bones soften, and appear like those affected with the disease called *mollities osseum*. Rodents do not seem to be affected by lactic acid, even after eleven months. Since lactic acid is to be found in the urine of rachitic patients, and Schmidt has found it in a long bone

affected with softening, the significance of Heitzmann's observation is obvious.

Rossbach has undertaken to determine the influence exerted by alkaloids on the oxidation processes of the organism. He concludes (1) that the various albuminates found in the body are affected and altered by the alkaloids; (2) that these changes are common to the alkaloids generally, though specific differences are to be observed; (3) that the alkaloids, while they leave the properties of hemoglobin as a generator of ozone unchanged, bind the ozone more firmly to the hemoglobin, so that it is less readily yielded up to other bodies; and (4) that hence the alkaloids do retard tissue-metamorphosis, both by the change which they produce in the albuminates and by the firmer fixation of the ozone.

Maly, in an elaborate paper on the origin of the free acid of the gastric juice, comes to these conclusions: (1) that the acidity is due to hydrochloric acid present; (2) that no lactic acid exists free in the gastric juice; and (3) that the source of the free hydrochloric acid is to be found in the decomposition of the chlorides present, a decomposition not effected by the action of any other acid.

Radziejewski and Salkowski have succeeded in detecting asparaginic acid in the intestines after pancreatic digestion. Since this acid has been proved to be one of the decomposition products of the albuminates, it occurred to the authors to ascertain whether the natural ferments of the animal body —such, for example, as that of the pancreatic juice—produced asparaginic acid as a product of its splitting action upon the albuminates. Well-washed fresh blood-fibrin was digested with the finely divided pancreas for several hours at 40°; asparaginic acid was detected in the resulting solution.

Hoppe-Seyler draws from his investigations the important conclusion that the consumption of albuminous matters in the organism takes place in the living cells of the tissues, and not in the lymph in which they are bathed, or in the blood itself, as has been hitherto maintained.

G. S. Johnson has published results which appear to prove (1) the existence of definite compounds of albumin with the acids in simple molecular ratios; (2) the applicability of dialysis to the ready and accurate preparation of these compounds; and (3) the probable correctness of the formula for

albumin of Lieberkuhn, $C_{72}H_{112}N_{18}SO_{22}$; of Loew, $C_{72}H_{106}N_{16}SO_{22}$; or of Liebig, $C_{216}H_{338}N_{54}S_3O_{69}$. Its molecular weight appears to be near 1720.

Matthieu and Urbain have examined the gaseous constituents of the blood, and the influences exerted by various internal and external conditions upon them. They show that repeated blood-lettings diminish the oxygen in arterial blood, because they diminish the intravascular pressure; that the chief seat of oxidation is not in the vessels themselves; that elevation of external temperature, by decreasing the osmotic interchange of gases through the pulmonary mucus, diminishes the oxygen dissolved in arterial blood, even in spite of the increased number of respirations thus caused; that the arterial oxygen varies directly as the atmospheric pressure; that the arterial oxygen is directly, and carbonic acid inversely, dependent upon the internal temperature; that muscular work increased to a limited extent arterial oxygen, a greater quantity of oxygen being consumed during work than during rest; that narcosis by morphine, and anæsthesia from chloroform, by diminishing the number of respirations, diminished proportionately the arterial oxygen; and that the percentage of arterial oxygen reaches its minimum about four hours after a full meal, though the total quantity is increased, but masked by the dilution. The smaller the animal, the less rich in oxygen is its arterial blood. Thickly furred animals have less arterial oxygen than others. At the extremes of life oxidation is less active, young adult blood being the poorest in oxygen.

Gobley has reinvestigated the character of Liebreich's protagon, obtained from brain matter, and concludes that it is simply a mixture of lecithin and cerebrin, two substances discovered by him long previous. The decomposition of protagon into glycero-phosphoric acid and neurine, observed by Liebreich, the author maintains is really a change in the lecithin present. Neurine is identical with choline discovered in the bile by Strecker. Bourgoin describes a simple method of obtaining cerebrin free from phosphorus, which is founded upon its solubility in hot alcohol.

Vogel has examined the reaction of fresh milk, and finds that it is in general transiently acid; though, since litmus-solution, reddened by milk, becomes blue when exposed to

the air, or placed in an exhausted receiver, he believes that it is due to carbonic acid.

Miescher has discovered in the spermatozoids of the Rhine salmon a new base, having the composition $C_9H_{20}N_5O_2$ (OH), which he calls protamine. It exists in the sperm in combination with nuclein.

Schenk has made a series of experiments on the effect of muscular activity upon the decomposition of albumin. He comes to the same conclusion which was reached long ago by Parkes and by Noyes, that there is no regular and close connection between muscular activity and the excretion of urea.

Hoppe-Seyler has given the following simple method for preparing uræmatin, the normal coloring-matter of the urine, from hæmatin, the coloring-matter of the blood: an alcoholic solution of hæmatin is treated with tin and hydrochloric acid; on evaporation a substance is left, brownish-red by transmitted, and a beautiful gold-yellow green by reflected light, corresponding in its deportment with urobilin. This substance is also produced by the reduction of urohæmatin. The author, therefore, believes that bilirubin and biliverdin, the biliary coloring-matters, as well as urohæmatin and urobilin, are only stages in the reduction of hæmatin. Baumstark has described two new pathological coloring-matters obtained from the urine of a patient suffering from lepra. The one is blue-black in color, soluble in alkalies with a garnet-red color, and has the composition $C_{68}H_{94}N_8Fe_2O_{26}$, or hæmatin in which H_8 is replaced by C_4. It is called uro-rubro-hæmatin. The other is black, soluble in alkalies with a brown color, and contains $C_{68}H_{106}N_8O_{26}$, or hæmatin in which the iron is replaced by hydrogen. He calls it uro-fusco-hæmatin. Hilger has sought to determine the cause of the peculiar odor communicated to the urine after eating asparagus. No asparagin could be detected; nor could any volatile organic body be isolated from the distillate, which possessed the characteristic odor. Comparatively large quantities of ammonium succinate were found, the hippuric acid was increased, and benzoic acid was detected. Donath has made some experiments to determine the cause of the acid reaction of urine. He shows that either hippuric, uric, or benzoic acid, on being added to disodium phosphate, withdraws sodium, and forms

mono-sodium phosphate, which is acid. The new equilibrium, however, is a very unstable one.

Traube and Gschleiden have investigated experimentally the two theories of putrefaction put forward respectively by Liebig and by Schwann—the chemical and the vital theories. They conclude strongly in favor of the second of these theories, and assert that even the most decomposable animal matters suffer no decomposition if care be taken to prevent the admission of organic germs from without; a proof that albuminous bodies in themselves have no power of self-destruction. They also experimented on the power of resistance to putrefaction possessed by living animals, and showed that putrefactive bacteria might be injected with impunity into the blood of living animals, and that they are at once killed by the gastric juice. Contagious bacteria, on the other hand—*Bacillus anthracis*—are capable of multiplying indefinitely in the organism, and hence cause pyæmia. But the authors have also proved the other curious fact that putrefactive bacteria are capable of destroying contagious bacteria. Gorup-Besanez has shown that leucin and tyrosin, which stand in the animal organism in such intimate relation to the albuminates, have certain relations with the vegetable kingdom also. He found leucin in considerable quantity in the etiolated sprouts of the common vetch; and he believes it is an intermediate product in the formation of legumin.

In *Applied Chemistry* the advance has been so great that only a few of the discoveries made can here be mentioned. E. Kopp's admirable report to the Swiss government upon the chemical products of the Vienna Exhibition has described many new and valuable processes. Among the most remarkable of these is the ammonia process for manufacturing soda from salt, which is destined to entirely replace the old process of Leblanc. Though patented in England as long ago as 1838, and though some commercial samples of soda thus made were exhibited at the Paris Exposition of 1867, it was not until the Vienna Exhibition that the process was shown to be a great commercial success. M. Ernest Solvay, of Couillet, exhibited there soda products made in this way, the capacity of their works being from 250 to 500 hundred-weights a day, or 80,000 a year. The process depends on the fact that sodium bicarbonate is less soluble in

water than sodium chloride; hence when a concentrated solution of salt is saturated simultaneously by ammonia and carbonic-acid gases, sodium bicarbonate separates from it. The success, commercially, of the process, arises from the skill and ingenuity with which the by-products are worked over. To decompose sufficient salt to produce 5000 kilogrammes of sodium carbonate would require, for example, in one operation, 5000 kilogrammes of the ammonia salt; while by a skillful rotation the production of 5000 kilogrammes of sodium carbonate a day only requires 250 kilogrammes per day of the ammonia salt.

The French Academy have devoted considerable time to a discussion of the use of lead in household economy. M. Fordos presented a paper showing that while potable waters containing carbonic acid do convert the lead into an insoluble carbonate deposited on the inside of the tube, yet that danger in the case arises (1) from the fact that this coating, being mechanically detached, may be introduced into the system; and (2) from a subsequent reaction between this carbonate and the chlorides and sulphates contained in the water, producing soluble sulphato or chloro carbonates. He also warns the public against the use of lead shot for cleansing bottles, having been told by a maker of wine-casks that the discovery of bottles in which such shot had been carelessly left was of daily occurrence. The danger is, of course, increased when the wine is put into such bottles, the shot not being removed. He recommends that the lead shot be replaced by clippings of iron wire, four or five millimeters long, Nos. 16–18 for large, and Nos. 20–22 for small bottles.

Salvetat has reported favorably to the Societé d'Encouragement upon M. Constantin's new pottery glaze, consisting essentially of sodium silicate, though containing also some lead. The frequent poisoning caused by the lead glazing ordinarily employed causes M. Salvetat to regret that M. Constantin had not gone a little further, and produced a glaze entirely free from this deleterious metal.

The Terre Noire Iron Company has patented a process for manufacturing cheaply an iron rich in manganese (ferromanganese), to replace the Spiegeleisen now so necessary in the manufacture of Bessemer or Siemens-Martin steel. It consists in treating in the high furnace blocks made up of

iron scrap, sponge, etc., with the manganese mineral. The ferro-manganese thus made contains 65 per cent. of manganese, and costs 2½ to 3 francs the kilogramme. But as only 2 per cent. of it is necessary in the bath, it can not be considered costly.

Frémy has published an elaborate report on cannon metal, in which he has given *in extenso* his own views upon copper-bronze alloys.

A considerable discussion has taken place on the question of the true constitution of bleaching powder, Goepner asserting the old view of Bertholet, that it is a compound of lime and chlorine directly, and Schorlemmer and others that it contains hypochlorite of calcium. Richters and Juncker, from their experiments, assign to the bleaching compound existing in commercial chloride of lime the formula $CaOCl_2$, but suppose that it is decomposed by water into $CaCl_2$ and $CaCl_2O_2$. Some of this latter product is always present in the commercial article, produced by the presence of moisture in the manufacture.

Bischof, of Glasgow, has introduced iron-sponge, in the state in which it is obtained by reduction from the ore without fusion, for chemically purifying water. The results thus far seem very satisfactory, the iron not only removing organic impurities, but also every trace of lead.

Melsens has succeeded in producing an excellent artificial bone-black for decolorizing purposes, by incorporating with wood-charcoal a solution of bone-ash in hydrochloric acid and subsequent ignition.

Hell and Medinger have been successful in isolating an acid of the composition $C_{11}H_{20}O_2$ from crude Wallachian petroleum.

Helbing has detected in the most volatile portions of coal-tar distillates three members of the olefine series of hydrocarbons. Amylene exists there in largest quantity, crotonylene next, and hexylene least.

Fontenay has analyzed a blue pigment used by the Egyptians fifteen centuries before the Christian era, and called by them *lapis imité*, and by Theophrastus Egyptian blue. It is essentially a copper silicate, containing some lime, alumina, and soda. It was successfully imitated by heating slowly to a high temperature a mixture of 70 parts of white

sand, 15 of copper oxide, 25 of chalk, and 6 of dry sodium carbonate.

Musculus has obtained what he calls soluble starch by heating ordinary starch with water and very dilute sulphuric acid to complete solution, the liquid still being colored violet with iodine. After neutralizing the acid, and evaporating the liquid to the consistence of a sirup, it deposits, after prolonged standing, minute grains of from 0.01 to 0.02 millimeter in diameter. After decantation, washing, and drying, it appears as a brilliant white powder, like starch, insoluble in cold water, but entirely soluble in water at 50° C. When dilute the solution is colored red by iodine; concentrated, it is turned violet.

Gal has submitted to examination the rare essential oil of the *Anona odoratissima*, ordinarily known in perfumery as ylang-ylang. He finds it to be a benzoic ether of one or several unknown alcohols.

M. Lamy has made a report to the Société d'Encouragement upon the Asnières establishment for the commercial manufacture of ammonium phosphate, for use in refining beet-sugar, as originally proposed by M. Kuhlmann twenty-four years ago. M. Peligot has also made a valuable report to the same society on the alloys in use for coinage.

Hatzfeld has proposed the injection of tannin or sodium tannate into wood, as a means of preserving it from decomposition. Dr. W. W. Keen has given the results of some striking experiments on the antiseptic powers of chloral hydrate, and on its use in preserving animal tissues for anatomical purposes.

Pasteur has himself given us, in a pretty full paper, the details of his new process for rendering beer unalterable in the air. From his investigations he had concluded: (1) That all alterations in beer, whether finished or in progress, or in the wort, are produced simultaneously with the development and increase of microscopic organisms; (2) that the germs of these organisms are carried in the air, or are left from previous operations either in the beer or attached to the vessels employed; (3) that a beer which does not contain these living germs is unalterable, whatever be the temperature of its production or preservation; and (4) that in actual practice all the worts, yeasts, and beers contain these germs. He

was therefore led to contrive an apparatus by which the still boiling wort could be cooled away from the air, and could be fermented by the addition of similarly treated yeast while it still remained in the tight vat. When now, after it is finished, it is drawn from this vat, it no longer furnishes the nutritive medium necessary to the development of the germs which produce the changes. Beer thus made may be preserved indefinitely, and appears not only to undergo no deterioration with time, but undergoes, like wine, an actual amelioration.

Jacquemin has been studying the influence of nitrogen in a textile fibre on the fixation, directly, of aniline colors. Since silk and wool readily take these colors directly, while cotton has to be animalized, or treated with albumin, etc., before it will receive the color, the impression is general that it is only to a nitrogenous substance that the color will unite. But that this is not so the author proves in the case of gun-cotton, which takes fuchsine or aniline blue as readily as silk; and, on the other hand, in the case of oxamide, which, though containing nitrogen, could not be colored by fuchsine though heated to 80° in a bath of it. The true reason for the difference observed between silk and cotton, in this regard, is yet to be determined.

MINERALOGY.

The department of Mineralogy has received its share of attention from the scientific world, but the special researches in crystallography and chemistry, all-important as they are for the full development of the science, can hardly be considered of general interest, and need not be referred to here.

The pages of the *Jahrbuch für Mineralogie*, Tschermak's *Mineralogische Mittheilungen*, Poggendorff's *Annalen*, etc., must be referred to by those specially interested in this subject. The occurrence of native tellurium and various tellurium minerals in Colorado and Montana has been made the subject of further investigations, and important papers descriptive of them have been published by Professor Silliman, Dr. Endlich, and Dr. Genth, and Schirmerite and Henryite have been added to the list of new tellurium minerals. Professor Cooke has made a valuable contribution to physical mineralogy in his paper on the Vermiculites. After a de-

scription of several species, including two new minerals, *Sterlingite* and *Hallite*, he discusses their optical properties, and explains the well-known diversity in the angle of the optic axes by a system of molecular twinning; exceedingly interesting and ingenious, if not very probable. He suggests the application of the same principle to the micas, and to other hexagonal minerals.

Professor Dana has recently published in the *American Journal of Science* an important paper on mineral pseudomorphism, descriptive of the changes which have taken place at the Tilly-Foster iron-mine at Brewster, N. Y. No less than eleven minerals are enumerated which have undergone a complete change to serpentine, together with a variety of other pseudomorphs of equally interesting nature.

An elaborate paper by A. Schrauf, of Vienna, and Edward S. Dana, treats of the thermo-electrical properties of various minerals, and sustains the conclusion that these properties are not dependent on hemihedrism, or peculiarities in crystallization, but are connected, in some cases at least, with differences in chemical composition, and always with differences in density.

The subject of micro-lithology continues to excite much interest; indeed, it is a question whether any kindred subject has at present more devotees. The elaborate works of Boricky on the "Basalts and Phonolytes of Bohemia," and Doelter on the "Trachytes of Hungary," of Allport and Hull on the English igneous rocks, will show what is being done to develop the subject of lithology. The large collections of igneous rocks made by the Clarence King party have been in the hands of Professor Zirkel, of Leipsic, and interesting results may be looked for in the report when published. The trap-rocks of the Atlantic border are now under investigation microscopically by E. S. Dana, and chemically by G. W. Hawes; and some of the results thus far obtained were brought before the meeting of the American Association at Hartford.

The following is an enumeration of the most important new species of minerals (see also above) which have been described during the year:

Dawsonite.—An interesting mineral, from a trachytic dike, near Montreal, and described by Mr. B. J. Harrington, of the

Geological Survey of Canada. It appears to be a hydrous carbonate of alumina, lime, and soda; and if this view be sustained, it is interesting as being a compound hitherto unknown, as well in the laboratory as in nature, if we except the doubtful Hovite of Gladstone.

Famatinite.—This name has been given by Stelzner to an antimonial Enargite, occurring in the Famatina Mountains in the Argentine Republic. *Luzonite* is another new mineral, nearly related, from the Philippines; described by Weisbach.

Foresite.—A new zeolite, from Elba; described by Vom Rath. In composition it is nearly related to Stilbite.

Kjerulfine. — A new phosphate of magnesia, resembling Wagnerite. It is found at Bamle, Norway, and has been described by Von Kobell.

Livingstonite.—Signor Bárcena has described this sulphide of antimony and mercury. It closely resembles Stibnite, and occurs at Huitzuco, State of Guerrero, Mexico.

Ludwigite.—A borate of magnesia and iron, from Morawitza, in the Banat; described by Tschermak.

Rhagite.—A hydrous basic arsenate of bismuth, occurring with Walpurgite, at Schneeberg; described by Professor Winkler.

Schröckeringite.—Professor Schrauf has thus named a new uranoxy-carbonate from Joachimsthal.

Vaalite.—A new mineral of the vermiculite group, from the diamantiferous rock of South Africa; investigated by Professor Maskelyne and Dr. Flight.

Veszelyite.—A new phosphate of copper, occurring on garnets, from Morawitza, in the Banat; described by Professor Schrauf.

Wheelerite.—A new fossil resin, discovered and described by Mr. O. Loew (and having the formula C_5H_6O). It was found in the cretaceous lignite beds of Northern New Mexico, filling fissures in the lignite, or interstratified in thin layers.

GEOLOGY.

Investigations in Western Texas by Jenney have revealed some facts of much interest with regard to the paleozoic rocks, and enable us to compare the strata of that distant

region with those along the northern and eastern borders of our great paleozoic basin. Near El Paso, the various members of the New York system, which make up the Cambrian, or so-called Lower Silurian series, are all met with, resting on crystalline granitoid rocks, and dipping westward at a gentle angle. At the base are 250 feet of sandstone, with *Scolithus*, regarded as Potsdam, followed by about the same thickness of gray limestone, holding forms like *Archeocyathus*, and supposed to represent the Calciferous. To this succeed 450 feet of gray magnesian limestone, with much hornstone, having apparently the fauna of the Chazy, and overlaid by 300 feet of limestones abounding in the characteristic forms of the Trenton and Hudson River formations — the Cincinnati group. Upon these rests a conglomerate, irregularly distributed, and sometimes 60 feet thick, made up from the ruins of the two last-named formations, which may represent the Oneida or Shawangunk conglomerate. It is instructive to find such a conglomerate, indicating a period of disturbance, alike in Eastern New York, in Ohio, and on the Rio Grande, coinciding with the conglomerate of the May-Hill sandstone in England, and marking in all of these regions a great paleontological break. Resting unconformably alike on this conglomerate and on the underlying formations are about 400 feet of gray crystalline limestone, with obscure fossils, which may be Niagara, but are considered more probably of Carboniferous age. It will be remembered that farther northward Shumard found Trenton and Hudson River rocks overlaid by the Carboniferous. Limestones of this period are widely spread over this region, and in some parts rest directly on old crystalline rocks, while elsewhere the Carboniferous limestone is found, with a thickness of 600 feet, resting upon 800 feet of sandstone, probably of the same period. No evidence is found in this region of the great series of strata containing the Medina, Niagara, Helderberg, and Devonian faunas.

Further information has also been obtained with regard to the geology of the great desert known as the Llano Estacado, the strata of which were supposed by Marcou to be Triassic and Jurassic, but are now known to be cretaceous. As seen at Castle Cañon, there is at the base 50 feet of a red sandstone without fossils, which is probably Triassic, fol-

lowed by about the same amount of a brown sandstone with cretaceous fossils, and by 500 feet of yellow limestone, with a well-marked cretaceous fauna. Beneath the red sandstone, in one locality, is seen a sandstone described as metamorphic, resting directly on micaceous gneiss.

Hitchcock, continuing his geological survey in New Hampshire, has proposed several subdivisions in the crystalline rocks of that region. Of these, he compares the older gneisses to the Laurentian, while the strata which he at one time called the altered Quebec group, after Logan, which were referred by Hunt to the Huronian, Hitchcock now considers to be of that age, but makes of them two subdivisions. We look for further details as to these older rocks. Meanwhile he has found in three localities limestones containing corals, crinoidal stems, and a *Pentamerus*, which belong to the summit of the Silurian or the base of the Devonian, and are therefore, in the nomenclature of the New York Survey, either Lower or Upper Helderberg. They are, according to him, associated with several thousand feet of sandstones, shales, and limestones, in part crystalline, which are believed to be of the same age. The difficulties in the study of these rocks are increased by the fact that, according to Hitchcock, the strata are so disturbed "that inversion is the rule rather than the exception." The fossiliferous limestones are of the same period as those found farther northward in the province of Quebec, and southward at Bernardston, in Massachusetts, from the study of which latter Dana concludes that the associated mica-slate series is also of Helderberg age.

The question with regard to the age of the lignites and plant-beds of the West, considered as cretaceous or tertiary, is much debated. It is evident that we had a great Mediterranean sea in the cretaceous time, extending from the Gulf of Mexico perhaps to the Arctic Ocean, in some parts depositing limestones with organic remains like those of the English chalk. With the drying up of this sea, dependent upon continental elevation, there were deposited great beds of estuary and fresh-water deposits, with lignites. But the strata which, on the evidence of the fossil flora, are regarded as tertiary contain the remains of a fauna which is looked upon as cretaceous.

Dawson, from a survey of the facts in the case, believes

that we have in the West the evidences of a gradual passage from the cretaceous to the tertiary beds, and that even in these latter it is not easy to distinguish definitely between eocene and miocene, so that what is regarded as one of the greatest breaks in the geological succession is here filled up. With the elevation came a contraction of the oceanic areas in which the animals of the cretaceous lived, while the tertiary life appeared on the higher levels, and slowly found its way down to the plains. So it happened that in Vancouver's Island plants which Heer regarded as miocene were washed into a sea holding cretaceous shell-fishes, and in the Fort Union lignite-bearing group cretaceous reptiles occur with remains of plants which appear to be unquestionably tertiary. These apparent anachronisms are, however, as remarked by Dawson, perfectly natural, and are to be expected whenever we meet with a true geological transition.

The evidence derived from the study of these beds of lignite shows that they are not due to accumulations of drift-wood, but are the remains of a vegetation which grew on the spot; they in some cases rest upon beds of under-clay with imbedded roots. With these beds of lignite are also associated layers and nodules of carbonate of iron like those found in older coal formations, and also beds of gypsum. Allen and G. M. Dawson have both of them lately described anew the curious pseudo-volcanic scoriaceous products which, in a great number of places in this formation, have resulted from the combustion of the lignites and the fusion of the overlying strata.

The evidences of immense erosion over the vast Rocky Mountain region are strikingly set forth by Hayden, according to whom the entire series of strata, from the lowest paleozoic to the highest tertiary, once extended in an unbroken mass over the whole Northwest, and is still seen entire in some places, as in the Cinnabar Mountains. From 10,000 to 15,000 feet of strata have been cut away, but portions of compact paleozoic limestones are found scattered over the Rocky Mountains at elevations of from 10,000 to 12,000 feet above the sea.

The immense volcanic outbursts of later tertiary time, which are so conspicuous in the geology of the Western coast, have been discussed anew by Joseph Le Conte. Extending from

Northern California and Nevada as far northward as British Columbia and Montana, they cover an area which may be estimated at between 200,000 and 300,000 square miles, with a supposed average thickness of 2000 feet, which, however, attains to over 3500 where the Columbia River cuts through the Cascade Mountains, giving in its gorge a grand section of these rocks. This immense volcanic deposit is here seen to overlie an ancient conglomerate layer, and beds of soil with impressions of leaves and the silicified roots and stems of plants of tertiary age. The operation by which lavas are discharged from ordinary volcanic vents is by Le Conte regarded as wholly inadequate to explain the formation of these enormous beds of igneous rock, which he supposes to have been poured out from fissures—the great movements which sometimes result in foldings of the earth's crust in other cases producing immense disruptions, followed by extravasation of liquid matter from beneath. These discharges were, however, not homogeneous, and the repetitions of doleritic and trachytic rocks show alternate and successive discharges at intervals. Richthofen, from his studies, endeavored to maintain a regular order in the succession of the different kinds of eruptive rocks described by him, but the facts observed by Le Conte are difficult to reconcile with such a view.

James Blake has recently studied with care the mineralogical and lithological character of these eruptive rocks, as seen in the Puebla Mountains in Humboldt County, Nevada, which consist, on their western side, of these rocks in conformable layers, varying from twenty to fifty feet or more, and dipping westward at an angle of about twenty degrees. The series, from the base to the summit, measures about 1200 feet in thickness. The alternations present great varieties in lithological characters. Among them are a compact dolerite or basalt, chrysolitic and chloritic dolerites, and a coarsely porphyritic one, containing twin crystals of labradorite an inch in length, with crystalline plates of augite. These are interstratified with trachytes, and toward the top with a vesicular trachytes and a porphyritic obsidian. From the association here observed, Blake concludes that the views of Richthofen with regard to the relative ages of eruptive rocks will not apply to those of the Puebla Mountains. Allport has also studied microscopically the dolerites of the British

Islands, both those of the Carboniferous and those of the Tertiary age, and finds the older and the later precisely alike in constitution and in structure, though the older he conceives to have undergone subsequent changes. The mineralogical elements of these dolerites include, besides feldspar, augite, and chrysolite, magnetite, apatite, mica, and a glassy matrix.

E. S. Dana has just given us the preliminary results of an important microscopic study of the trap rocks of the Connecticut Valley, the harder and more crystalline varieties of which, according to him, consist of labradorite, pyroxene, and magnetite, more rarely with chrysolite and apatite. The pyroxene in the coarse-grained dolerite often appears in long-bladed prisms somewhat resembling hornblende, and hitherto mistaken for that mineral. Some varieties of this rock contain four or five per cent. of water, and hold much chlorite, partly in plates, seeming as if formed from the pyroxene, and partly in cavities. The soft, light-green amygdaloidal varieties are highly hydrated, and contain chlorite, quartz, and datolite. These he conceives may result from a subsequent change of the anhydrous dolerites.

Hull and Judd have described the great volcanic outflows seen in the north of Ireland and the Hebrides. According to the former, there were no traces of volcanic rocks in the Lower Cambrian, but in the Upper Cambrian are found sheets of acidic feldspar rocks, with others hornblendic. These he regards as probably resulting from submarine eruptions. This was also a period of volcanic activity in Wales and in Cumberland. In the Upper or true Silurian period sheets of quartziferous porphyry are found alternating with sandstones, conglomerates, and shales. Similar phenomena occur in the Devonian sandstones in Ireland, where in Killarney is a mass of columnar feldstone, an old volcanic neck or throat, near to which are beds of volcanic ash and conglomerate, including hollow balls or volcanic bombs. Similar volcanic necks are seen in the Carboniferous, and outflows of lavas, sometimes acidic, but chiefly basic, consisting of dolerites, containing, besides a triclinic feldspar and augite, chrysolite, chlorite, and magnetite. In Tertiary times there was apparently a still more abundant outflow of lavas in this region, which formed a part of the great volcanic belt to which Iceland, Central France, the Iberian Peninsula, the Azores, Ma-

deira, the Canaries, the Cape Verde Islands, Ascension, St. Helena, and Tristan d'Acunha belong; all of which, as the *Challenger's* late soundings have shown, formed parts of a mountain range, comparable in extent, elevation, and volcanic character with the Andes of South America. The area of these Tertiary eruptive rocks in Ireland and the Hebrides is estimated at over 2200 square miles, and their aggregate thickness from about 1300 feet in Antrim to between 3000 and 4000 feet in the island of Mull. These eruptions were subaerial, and belong to three periods—the first probably of later Eocene, the second and third of Miocene age. Zirkel recognizes among the tertiary volcanic rocks of Ireland trachytes, felsites, and pitchstones, as well as dolerites. The last, whether coarsely crystalline or basaltic, have essentially the same mineral composition, a fine-grained base or glass from which the feldspar, augite, and chrysolite have individually crystallized. The basalts are in large part of augite, and are often highly charged with titanic iron ore. Lava streams, dikes, mountain masses, scoriæ, ashes, and volcanic breccias, inclosing fragments of older sedimentary rocks, are met with, and the currents of the basic lavas have been traced fifty or sixty miles, though the trachytic ones appear to have flowed much less distances. In these tertiary eruptions, as in those of Paleozoic age, above noticed, the trachytic seem to have preceded the augitic lavas, and the close of the period in the later miocene was marked by small volcanic cones, as in Auvergne. In each of these periods there were outflows, with intervals of repose sufficiently long to allow of the sub-aerial decay of the surfaces, giving rise to beds of clay and to aluminous iron ores. The so-called bole or laterite is the doleritic rock decayed *in situ*, and retaining its original structure.

The sub-aerial decay of crystalline rocks, noticed in our *Record* last year, has been further studied by Hunt. He has shown that at the western base of the Hoosac Mountain, along the line of the great tunnel, there are from 200 to 300 feet in thickness of gneiss, so soft as to be excavated like clay and gravel, yet retaining the structure and arrangement of the original beds, which are nearly vertical. He has further described the same phenomenon at the northwest base of the South Mountain in Pennsylvania, where nearly vertical soft

strata, which have been regarded as primal paleozoic, are, according to him, decayed crystalline schists, probably of Huronian age. The interstratified layers of hydrous iron ore and brown hematite which they contain are regarded by him as a result of the oxydation of beds of pyrites in the original schists. A similar bed of limonite is found in the decayed strata at the Hoosac Tunnel; and Professor C. U. Shepard long ago pointed out that the brown hematite ores of Northwestern Connecticut belonged to decayed crystalline schists, and were probably derived from the alteration of pyrites.

Dawson, from his recent studies of the flora of the Upper Coal Measures of Prince Edward's Island and Eastern Nova Scotia, shows that there is here a passage from the Carboniferous to the Permian, thus bridging over the interval which in Eastern North America has hitherto divided the Carboniferous from the Trias, which in most cases rests unconformably on our older crystalline rocks. Woodward proposes anew to group together in one series, under the old name of Pœcilitic, proposed by Phillips, the strata from the coal to the Rhætic beds at the base of the lias, thus including Permian and trias.

The question as to the nature of glacial agency, and to the part formerly played by land-ice, continues to occupy the attention of a large number of geologists. Bell, from his late observations in Nicaragua, supposes that, even in tropical America, glaciers at one time came within 2000 feet of the sea-level, and finds the evidence of their action in deposits of sand, gravel, and supposed moraines, though admitting the absence of scratches on the rocks. According to Mr. Tylor, the polar ice-cap, as conceived by Agassiz, would contain so much ice abstracted from the sea as to reduce the level of it 600 feet, while Mr. Bell, who supposes that the ice-cap would be present simultaneously at the two poles, admits a lowering of the sea equal to 1000 feet. Shaler, however, shows that an ice-cap extending over both hemispheres from the poles to 45°, with an average thickness of one mile, would reduce the sea's depth over half a mile. Regarding all the great horizons of conglomerate rocks as periods of glaciation, he indicates the following: The Lower Cambrian, the close of the Cincinnati group, the beginning of the Coal period, the Trias, besides probably three periods in the Tertiary. Re-

jecting all the other explanations of the supposed change of temperature implied in these glacial periods, he adopts the view that our sun is a variable star. The sudden increment of its heat by one half would make the tropical region the seat of enormous evaporation, and the polar regions one of excessive precipitation, resulting in the great circumpolar glaciers.

Croll, who has done so much to develop the hypothesis of universal land-glaciation, has discussed the question of the glacial phenomena of Southern England, and maintains that a great ice-sheet once filled the Baltic and the German Oceans, and spread over to England, while Prestwich and Whittaker maintain the submarine origin of the glacial drift of Southeastern England.

Evans, the president of the Geological Society of London, rejects the doctrine of great ice-caps, since it involves the destruction and recreation of the entire fauna and flora of regions. According to McKenna Hughes, the hypothesis of ice-caps accounts for no facts which can not be otherwise explained, while it involves great physical difficulties, and is quite inconsistent with the continuity of the forms of life from pre-glacial to post-glacial times. He questions whether glacial phenomena were ever simultaneous even over one hemisphere, and maintains that in Scandinavia there is evidence that boulders have been carried northward as well as southward. Campbell, from his studies in Northern Russia, while admitting the former existence of local ice-systems, rejects the notion of a universal ice-cap, and attributes much to equatorial and polar currents, such as now move in the Atlantic.

Dawson, in like manner, has shown that drift on Prince Edward's Island includes not only boulders from the northward, coming from Labrador, but others from the southward, from the hills of New Brunswick. He has again discussed the phenomena of glacial drift in the St. Lawrence Valley, and points out the fact that on the south side of the mountain of Montreal the earthy paleozoic limestones have been deeply affected by sub-aerial decay; while on the northeast side there is no trace of this, but the same limestones are, on the contrary, polished and glaciated by a force which, by its action on the transverse trap dikes, is shown to have been from the northeast, or up the valley of the St. Lawrence. He concludes that it is impossible that these results could have

been effected by any thing but floating ice coming from the northeast, and that the great agent in denudation was the arctic current passing over the region when submerged.

GEOGRAPHY.

In *Geodesy*, the steady activity of innumerable workers prevents our noting more than a comparatively few events, such as the publication by the French government of the first sheets of the new Topographical Map, on a scale of $\frac{1}{500,000}$, with contour lines for each one hundred meters. These are the first results of the survey ordered in 1870.

The field mark on the central European arc of longitude, extending from Valentia, Ireland, to Orsk, in Asia, having been completed in 1872, it is estimated that the computations will occupy still another year. The office work is conducted under the supervision of the Russian geodesists, through whose dominions two thirds of the triangulation extends. Accurate surveys of Hayti are also in progress.

The principal new geodetic work that is at present contemplated is in connection with the determination of the positions of that part of the globe covered by the stations for the observation of the transit of Venus.

The question of determinations of altitude by means of accurate levelings has been treated of in several interesting essays, both theoretical and practical, concerning the errors incident to such operations. We note especially the determination by Baeyer of the errors in the German survey that depend upon local deviations of the plumb-line. Still more numerous have been the essays on the use of the barometer for the determination of altitude; of which we can make special mention only of the very clear and practical work of J. D. Whitney and W. H. Pettee, published by the Geological Survey of California.

A complete remeasurement of the area of Russia has been made by the use of the Amsler Planometer, as applied to the improved charts of the present day.

We have not heretofore announced the completion by the Coast Survey of two new base-lines — one extending from Farmington, Maine, to Nantucket, and the other from the head of Chesapeake Bay to Ocracoke. A base-line of 48,100 feet has been measured by Major Powell in the Cañon region

of the Colorado. A second base for reference in Dr. Hayden's surveys has also been measured under the direction of Mr. Gardner.

Several works have lately been published giving the altitudes of various points throughout the United States. One of these belongs to the series of reports of Professor Hayden's survey, referring more particularly to the Rocky Mountain region and the West; while the other, "The Dictionary of Elevations," by Dr. J. M. Toner, of Washington, is intended more particularly as a contribution to medical science, having special reference to the connection between altitude and the occurrence of particular diseases. From this we learn that yellow fever, in particular, is absolutely limited in its origin to localities having an altitude of less than five hundred feet, although cases carried above that elevation may prove fatal.

Hydrography and Navigation.—These subjects have received due attention during the year from the various nations of the world, extensive field labors having been prosecuted, and a large number of charts of harbors, shoals, and other positions, important in navigation having been published by different hydrographical establishments.

The United States Coast Survey has conducted operations along the sea-coast of the United States, including a large portion of Alaska. Special information regarding explorations in the latter region will be found farther on. It has published tide tables for both coasts of the United States, and other important works, including numerous charts. The Engineer Bureau has continued its survey of the Great Lakes, by methods which constitute a great advance upon those employed in the earlier parts of its work; and the Secretary of War has suggested the importance of renewing the labor from the beginning, so as to secure uniform and equally satisfactory work throughout. The United States Hydrographical Bureau has published many aids to the navigator in the way of charts, notices to mariners, sailing directions in various parts of the world, etc. Among the most important of these works are: No. 46. The West Coast of Africa; Part I.—from Cape Spartel to Sierra Leone; No. 52. The coasts of Spain and of Portugal; No. 56. Remarks on the coasts of Lower California and Mexico, by Commander George Dewey;

No. 57. Tables for finding the distance of an object by its bearings; Practical papers of the Hydrographic Office; Nos. I., II., IV. List of foreign lights, i.-iv.; No. 54. Deep-sea soundings in the North Pacific Ocean, obtained by the United States steamer *Tuscarora*, Commander George E. Belknap.

The "Nautical Almanac" for 1877 has been printed by the Nautical Almanac Bureau, under the charge of Professor Coffin. In addition to the usual regular components of the volume, it contains corrections of the Ephemerides of Uranus for the years 1873 to 1876 inclusive, prepared from Professor Newcomb's tables; a table of logarithms of sines and cosines, with the argument in time; and tables for finding the latitude of a place by the altitude of the pole-star.

A new determination of the difference of the longitude between Washington and Greenwich has been made by the Coast Survey, which, although very much the same as that last obtained by that service, varies from what has previously been considered the true difference.

The Deep Seas.—The progress of geographical discovery during the year has been largely connected with the operations of the *Challenger* and of the *Tuscarora*, so far as the ocean is concerned, and those of the Austrian Polar expedition of the *Tegethoff*, although various interesting facts have been added, from various regions throughout the world, that tend to extend our knowledge of the subject.

Messrs. Behm & Wagner have published their annual summary of the population of the world, as obtained by the latest reports and estimates, the footing for the year 1873 amounting to 1,300,000,000 souls.

The movements of the *Challenger*, as being the most important expedition for oceanic exploration, continue to be noted by all nations with great interest. This vessel reached St. Simon's Bay, in South Africa, toward the end of the year 1873, and, after refitting, proceeded to Melbourne, visiting on the way Kerguelen's Island, and other localities in the antarctic seas proposed as stations for the parties engaged in the observation of the transit of Venus, arriving at Melbourne on the 17th of March, her most southern latitude on the way being 66½°.

Her programme, after leaving Australia, was to carry a line of soundings to New Zealand and the Coral Sea; next to

New Caledonia, New Guinea, Macassar Strait, Manilla, Celebes, and other islands, which would probably occupy the rest of the year 1874. The doubtful islands of the South Pacific were then to be looked up, New Ireland and the Solomon and Pelew Islands visited, and finally Japan reached by March, 1875. From Japan a passage was to be made across to Vancouver's Island, and thence to Valparaiso, by the end of 1875; and, after passing through the Strait of Magellan, and visiting the Falkland Islands, the vessel was to return home by way of the Ascension Islands by the middle of the year 1876. How far this programme will be interfered with by the reported appointment of Captain Nares to the charge of the new British Polar expedition remains to be ascertained. When last heard from (November 15) the vessel was at Hong-Kong, having visited the Fijis.

As usual, the track of the *Challenger* has been accompanied by interesting discoveries in physical and natural science, numerous new species of animals and plants having been collected, and noteworthy facts ascertained in regard to the physics of the sea. An important generalization has even been made in regard to the geological condition of the earth, and the formation of sedimentary strata. Among those of the highest importance may be mentioned the explanation of the gradual passage of the chalky ooze abounding in shells and other calciferous matter into a uniform homogeneous red mud, with little or no trace of calciferous life, the former condition occurring down to a depth of about 1500 fathoms, or along the ridges of the sea-bottom, and the latter representing the much lower levels between them. In the opinion of Sir William Thomson, this is due to the fact, as shown by observation, that the deeper strata are very rich in carbonic acid, this forming more than one third of the gaseous component of the water. This composition, together with the very great pressure exercised, causes a rapid solution of carbonate of lime, leaving only the other constituents. This has its counterpart in various well-known terrestrial strata, where a limestone abounding in shells, etc., passes insensibly into a slate entirely free from well-marked organic remains, excepting those originally of siliceous or membranous character. It is difficult to exaggerate the value of such observations in their geological relationships.

During the present year the United States steamer *Tuscarora*, Commander George E. Belknap, has been employed in taking deep-sea soundings in the North Pacific Ocean, for the purpose of ascertaining a practicable route for a submarine cable between the United States and Japan. The northern and southern routes between these countries have been examined by running lines of soundings. The line on the former route commenced at Cape Flattery, touching the Aleutian Islands, skirted the coasts of the Kurile Islands, and terminated at Yokohama, Japan. On the latter route the line commenced at San Diego, California, touching the Hawaiian and the Bonin Islands, and terminated also at Yokohama. Besides these lines of soundings, others were run on and off shore between Cape Flattery and San Diego, for the purpose of determining the continental outline, or the commencement of the ocean-bed proper. Having completed the duty in question, the vessel returned to San Francisco, and Commander Belknap himself has been detached and ordered to duty with the Coast Survey.

A course for a cable was marked out, sufficiently gentle in its slope and of suitable condition of sea-bottom for such an enterprise. It being thought expedient to survey a more direct route, the vessel has been again ordered into service, and is now engaged in a line of soundings from San Francisco to the Sandwich Islands, and from that point, possibly, to Australia and to Japan.

Samples of the sea-bottom at each sounding were obtained and transmitted by the Navy Department to the Smithsonian Institution, the authorities of which placed them for examination in the hands of Professor Hamilton L. Smith, of Geneva, N. Y., an expert in this branch of science. This gentleman has already obtained some extremely interesting facts, as well as many new species of microscopical objects.

Among the other operations prosecuted under the auspices of the Hydrographic Office of the United States Navy, may be mentioned the following:

A survey of the coasts and gulf of Lower California, and of the Revillagigedo group. This has been nearly completed, and the preliminary charts will be issued (in four sheets).

A running survey of the gulf coast of Mexico has been made by Lieutenant-Commander Green, of the United States

steamer *Fortune*, from Vera Cruz to Laguna de Terminas, completing the running survey carried during the last year from the Rio Grande to Vera Cruz by Commander Baker, of the United States steamer *Wyoming*, the charts of which are on hand for completion. The expedition under this Office for the correct determination of longitude by the electric cable in the West Indies, which was delayed during the last season by the Cuban difficulty, has started on its work under the command of Lieutenant-Commander Green, of the United States steamer *Fortune*.

A survey of the vicinity of Flores Island, at the entrance of the Rio de la Plata, as also a survey from thence to Punta Brava, along the northeastern shore of the Rio de la Plata, was made by Commander Mahan and officers of the United States steamer *Wasp*.

A survey of Palmyra, Washington, and Christmas Islands, in the North Pacific, was made by Commander Skerrett and officers of the United States steamer *Portsmouth*.

Commander H. L. Howison, U. S. N., of the United States steamer *Shawmut*, and Commander A. V. Reed, U. S. N., of the United States steamer *Kansas*, have also been employed in surveying doubtful points in the West Indies.

A new marine meteorological journal has been issued by the Hydrographic Office for the purpose of collecting information, etc., for the correction and the continuance of the wind and current charts, suspended during the last fifteen years.

One hundred and twenty-six (126) charts have been compiled, and engraved or photolithographed during the year.

Of minor extent, in the line of deep-sea work, we may mention the operations of the United States Naval steamer *Blue Light* on the coast of Connecticut, while engaged in the service of the United States Fish Commission. Apart from the collections obtained by means of the dredge and trawl, soundings were made and deep-sea temperatures observed.

The operations of the German Commission for investigating the northern seas have been continued, under the direction of Messrs. Meyer, Möbius, Karsten, and others, during the year, although no formal report of the results has appeared.

The proposed exploration of the seas of Norway, by Professor Mohn, director of the Astronomical Observatory of

Christiania, and Mr. G. O. Sars, the eminent Norwegian zoologist, will probably be entered upon during the coming year.

The Arctic Regions.—No new enterprises in the way of Arctic exploration of any special moment were initiated during the year 1874, the much-talked-of British expedition having failed to be organized. It is now, however, authoritatively announced that the British government has decided to proceed at once to the fitting out of a first-class expedition for 1875, to include two vessels; one, probably a steam whaler, to be stationed at some convenient point, to serve as a relief, the other, a government ship, to move as far forward as the ice and other physical conditions will permit. The labor of fitting out the expedition will be under the charge of Admiral Sherard Osborn, a veteran arctic explorer. It is said that Captain G. O. Nares, of the *Challenger*, has been appointed to command the entire expedition, while it is probable that Captain Alfred H. Markham will also be engaged in it, perhaps as commander of one of the vessels. Captain Nares has already had an arctic training, as he served on board the *Resolute* in the expedition of 1852–54 with M'Clintock. More persons have already volunteered than would be needed for a number of vessels.

Our last Summary announced the safe return of all the members of the American Arctic expedition, which left under the charge of Captain Hall in the steamer *Polaris* in 1871, the only casualty, as there stated, having been the death of Captain Hall himself. Since then a report of the cruise has been published by the Secretary of the Navy, with a brief summary of the scientific results, accompanied by a map showing the nature and importance of the discoveries made by the expedition. Dr. Bessels, the surgeon of the *Polaris*, and the chief of the scientific party, is now in Washington, engaged in making up a full report upon what was accomplished during the voyage; and the first volume will probably be ready for the press early in 1875.

Several small parties left Northern Europe in the spring of 1874 for the purpose of proceeding to Spitzbergen, and elsewhere in the North; among them Captain Wygand, who chartered Mr. Lamont's steam-yacht the *Diana*, and left Dundee about the first of June. He spent some time in Nova

Zembla, and returned without having added any thing of special interest to our knowledge of the far North.

The most important geographical event of the year, as already referred to, is the safe return of the Austrian Polar expedition, which left on the *Tegethoff* in 1872, and of which nothing had been heard until quite recently. Several parties were sent out, or proposed, during the present year as a relief, and the services of the many Norwegian sailors who annually visit the arctic seas for the purpose of capturing the whale, seal, and walrus, were enlisted by the offer of a reward of one hundred pounds sterling for the first news.

As just remarked, this party left on board the steamer *Tegethoff* in June, 1872, and sailed from Tromsö on the 13th of July. On the 26th of August she parted company with the yacht commanded by Count Wiltzec; since which nothing had been heard of her until the 3d of September, 1874, when her officers and crew reached Vardo, in Norway.* It appears that the vessel was beset in the ice off the northern end of Nova Zembla the very day that she parted company with Count Wiltzec; and drifted for the next fourteen months, until October, 1873, first in a northeasterly direction, and then northwest. The expedition wintered in 1873 and 1874 in latitude 79° 59′, longitude 59° E. Snow huts were built upon the ice, and the necessary preparations made for the scientific work of the expedition.

The most important discovery was that of land to the north of Nova Zembla and northeast of Spitzbergen. This was explored quite thoroughly as far north as 81° 52′, and was seen to extend as far as 83°. A large portion of this land was covered with glaciers, sending up through the ice conical peaks of dolomite rocks.

The newly discovered country throughout its entire length has been called Franz-Joseph's Land.

The expedition set out on its return journey in three boat-sledges, and proceeded first to the vicinity of the vessel, and finding it still frozen up, they essayed to reach the mainland of Northern Europe. It was not until the 15th of July that they were fairly off, and not until the 15th of August that

* It may here be remarked that this port has, it is said, been purchased by the German Polar Exploration Society, as a starting-point and station for its expeditions.

open water was met with. Cape Nassau, on Nova Zembla, was seen three days afterward; and sailing along the coast of that island they reached Vardo on the 30th of September, meeting at Hammerfest the English schooner *Diana*, which was about starting out in search of them.

As incidentally connected with the subject of arctic exploration for the year, we may refer to the Dundee whaling fleet in Baffin's Bay. The operations of these vessels, about ten in number, were very successful, each one bringing home on an average one hundred and thirty tons of the oil. One of these, however, the *Arctic*, under command of Captain Adams, was wrecked on her voyage. This fact has peculiar interest to Americans, as it was to this vessel that a portion of the *Polaris* crew were transferred after their rescue by the *Ravenscraig*, and brought to Dundee. She had previously made eight remunerative voyages, and had paid the cost of her construction many times over. She was crushed by the ice near Cape Garry, and became a total loss, having first taken fire, and then gone down stern foremost. Captain Adams and his fifty-four men, although exposed to severe hardships, were rescued and brought safely home on the other vessels of the fleet.

The safe return of the *Tegethoff* party has apparently stimulated the Austrian government to new efforts, and it is announced that there will probably be two expeditions sent out from that country during the coming season; one to make a renewed effort to penetrate the North between Spitzbergen and Greenland, and the other to move either by way of Smith's Sound or through Behring's Strait.

We have already referred to the proposed action of the British government, and it is much to be desired that the United States may not be behindhand in the generous rivalry for the satisfactory solution of the various problems in regard to the arctic land. It has been suggested, if the Smith's Sound route be sufficiently provided for by the European parties, that an expedition be fitted out at some point on our west coast to proceed as early as June, by steamer, to the North. Such a vessel as the Coast Survey steamer *Hassler* could, it is thought, be readily adapted for this purpose. A special encouragement to such a suggestion is to be found in the fact that the seas north of Behring's Strait

have been remarkably free from ice for several seasons past; and, indeed, it is said that a whaler during the past summer was within three miles of the shores of Wrangell's Land, on which a landing could readily have been made, and that other whalers far to the northwest found not the slightest obstruction to the prosecution of their labors in any direction of the horizon. The mouth of the Mackenzie even was reached by whalers without any interruption from ice, a previously unheard-of circumstance. It is understood that a number of the members of the *Polaris* party, including Dr. Bessels, are ready to volunteer their services, and that the New York *Herald*, with its characteristic liberality and enterprise, has offered to pay half the expenses.

North America.—Not the least important exploration in America has been that conducted by Mr. W. H. Dall, as a branch of the varied and extensive operations of the United States Coast Survey. In 1871, under the auspices of the United States Coast Survey, a hydrographic reconnoissance of the coast of Alaska and the Aleutian Islands was authorized, and placed in charge of Mr. Dall, whose previous experience in this region had to some extent prepared him for this work. The party, with Mr. M.W. Harrington as astronomer, left San Francisco in August, 1871, on the United States surveying schooner *Humboldt*. The party wintered in Unalashka, returning to San Francisco in October, 1872. The work accomplished during this season was principally carried on in the vicinity of Captain's Bay, Unalashka, and in the Shumagin Islands. A reconnoissance chart of the Shumagin group, hitherto little known, with detailed charts of the harbors and principal anchorages, contained the first information of a large number of islands and harbors previously unknown. The existence of an important oceanic current, with its extent, temperature, and direction (to the westward from the Gulf of Alaska south of the Aleutians), was demonstrated by numerous observations. A trigonometrical survey of Captain's Bay was begun; and observations on tides, meteorology, sea temperatures, heights of mountains, with numerous soundings and astronomical observations, were obtained.

The party left San Francisco on the new schooner *Yukon* in May, 1873, with Mr. Marcus Baker as astronomer, and again returned in November. During this season a chain of astro-

nomical positions, with magnetic observations for declination and dip, were carried to the westward through the Aleutian Islands from Unalashka. The results obtained necessitated many important changes in the charts. At the same time, the general miscellaneous observations of a hydrographic nature, previously enumerated, were carried on, a detailed survey of Kyska Harbor (with a view to its use as a landing-place for telegraphic cables) and of Iliuliuk Harbor were made, and the season's work was finished by additional surveys in the Shumagin Islands.

The work of the season from April to November, 1874, by the same party, was still more important. It extended from Sitka to Unalashka south of the islands, and included the Pribiloff group, part of Nunivak, Bristol Bay, and Aliaska Peninsula north of the Aleutians. The most important works accomplished were extensive rectifications of the coast-line between Cape Spencer and Mount St. Elias, mapping the glaciers, and making the most careful measure yet obtained of Elias, Fairweather, Crillon, and other high peaks of this region. Also, fixing the astronomical position of some twenty-four stations, including Lituya Bay, Mount St. Elias, Port Mulgrave, Middleton and Chirikoff Islands, Port Etches, Port Möller, the Semidi and Pribiloff Islands, Nunivak, Hagmeister, and a number of other islands; surveys of the Semidi Islands, parts of Aliaska Peninsula, and extensions of the survey of Captain's Bay, besides numerous harbors; extending largely the chain of magnetic stations, and the materials for a "Coast Pilot."

During the entire period occupied by these investigations, the leisure of the party was employed in making notes and collections of natural history, geology, and ethnology, the results of which have been placed in the National Museum; and which are especially rich in prehistoric ethnology, marine invertebrates, and material toward a knowledge of the geographical distribution of the fauna and flora of these regions.

Congress at its last session passed a bill authorizing the appointment by the Secretaries of the Treasury and of the Navy, respectively, of an agent to visit conjointly the islands off the coast of Alaska, with a view of determining the geographical distribution of the fur-seals, and of inquiring into

the fidelity with which the Alaska Commercial Company may have kept its obligations to the United States and to the people of the territories. Mr. Henry W. Elliott, already favorably known from his previous explorations in the same region, and Lieutenant Maynard, were selected, and left on the revenue vessel under charge of Commander J. G. Baker. They visited Sitka, the islands of St. Paul, St. George, St. Lawrence, St. Matthews, etc., and returned to Washington with the materials for their report. It is expected that another year will be occupied in completing this research, and in collecting facts for the final statement of the results of their labors.

Of the regular government expeditions, the most extensive in its preparation and organization was that of Lieutenant George M. Wheeler, which embraced nine different parties, each thoroughly organized and provided with transportation, and the means of both physical and natural history work. A large area of country was thoroughly explored and mapped out, while the biological collections were of very great value. One of Lieutenant Wheeler's parties, consisting of Dr. Yarrow, Professor Cope, and their associates, succeeded in discovering and exploring immense deposits of vertebrate fossils, said to include over one hundred species, a number of them new to science. The zoologist of the expedition, Mr. H. W. Henshaw, secured a large series of birds, reptiles, insects, etc., among them at least five kinds of birds hitherto unknown within the limits of the United States. The botanist, Dr. Rothrock, also gathered a large number of plants, some of them previously undescribed.

Professor Hayden's parties were also actively engaged, the results, however, being rather in the line of topography, general geology, and terrestrial physics, than in natural history proper.

Professor Powell has also continued his work on the Colorado River with his usual success, returning to Washington with valuable material. The labors of Lieutenant Wheeler were prosecuted under the War Department, those of Dr. Hayden and of Major Powell under the Interior Department, forming the two divisions so far organized of the proposed geological survey of the territories.

A more detailed statement of the operations of these three

parties will be found in the chapter on *Geography*, and to that we refer our readers for fuller information.

An important reconnoissance was made during the past year by General Custer with a large force into the region of the Black Hills. He was accompanied by several scientists, who prosecuted the necessary examination into the natural history and geology of the region. Nothing of any special scientific value was ascertained beyond the occurrence of a rich body of vegetation and a considerable variety of animal life. The question whether gold occur there in paying quantity is still in dispute.

Professor Stoddard, of the Wooster University, headed a party during the past summer in exploration in Colorado, and succeeded in obtaining some fine collections of minerals, several hundred species of plants, and many skins of animals.

During the winter of 1873–74 an expedition was fitted out for exploration in Central Florida by *The Forest and Stream* newspaper of New York, Mr. Frederick Ober being placed in charge, and being accompanied by Dr. Edward Palmer and Professor J. W. P. Jenks. The special object of Mr. Ober was to explore Lake Okeechobee, which was but little known, and about which many questionable stories were prevalent; among them that of the existence of remarkable animals, as also of ruined cities showing a former high state of civilization. Nothing of the kind was detected; the lake was found to be forty miles long and twenty-five wide, and but scantily supplied with animal life.

Professor Marsh, the indefatigable paleontologist, has been again discovering new fields for exploration in the form of bone beds in the *Mauvaise Terres*, not far from the Red Cloud Agency. He started in the month of November for this region, but was at first materially interrupted by the jealousy of the Indians, who could not believe he was in search of bones and not of gold; but finally the Indians became pacified, and a number of them accompanied the Professor both as escort and as spies. He has returned with a rich harvest, estimated at several tons of these precious treasures.

The survey of the northern boundary of the United States, of which Mr. Archibald Campbell was commissioner, and Major W. J. Twining chief astronomer, has been completed

during the year, the whole work—a labor of immense magnitude—having been accomplished in three seasons. This boundary was surveyed and marked from the Red River of the North westward to longitude 106° 12′ in the summer of 1873; and in the succeeding winter the survey was carried east from the Red River to the Lake of the Woods, including its shores lying as far east as Rainy River. The surveying service was organized on the 1st of June 1874, at St. Paul, and the party proceeded to Fort Buford, reaching the initial point of the year's operations on the 1st of July. The working parties were pushed forward to the utmost limit of their endurance, and by the 1st of September the remaining 358 miles, extending from longitude 106° 12′ to longitude 112° 05′, was completed, and eight astronomical stations determined. This work was done conjointly with the British division, each determining a series of astronomical stations, and surveying a field of territory five miles wide on its side of the line.

The American party returned to St. Paul by way of the Missouri River in an open boat, making the distance of 1200 miles from Fort Benton to Bismark in 18 days. Thus, in four months, a journey of 3700 miles—900 by land and 1200 in an open boat—was completed, besides surveying 358 miles of boundary-line. The expedition was accompanied this year, as the last, by Dr. Elliott Coues as surgeon and naturalist, who, as before, made very important collections in general natural history, and will be able to furnish a valuable report upon the animal, vegetable, and mineral resources of the region.

The country passed over from longitude 106° to the Milk River proved to be quite unattractive, the rain-fall being small, and the water consequently scarce during the summer. From the Sweet Grass Hills to the Rocky Mountains its character greatly improved, there being an ample rain-fall, giving promise of a fertile country. Immense herds of buffaloes were met with, which, in the opinion of Major Twining, appear to be increasing rather than diminishing. The territory is the region of the Blackfoot and Piegan Indians, though visited occasionally by other tribes.

It may be mentioned, in this connection, that this northern boundary-line of the United States was completed in the period of 1855 to 1860, from the Pacific coast to the longitude

of 114° 5′, which, with the work done many years ago under Colonel Graham and others, makes a continuous survey from ocean to ocean. There still remains the demarkation between Alaska and the British Possessions in North America, which it is hoped may be undertaken before long.

Various other enterprises in the way of demarkation of interstate and territorial boundaries have been prosecuted during the year; but it is hardly necessary to bring them under review. We may, however, here mention the proposed enterprise by the State of Massachusetts in the way of a new physical and scientific survey of its territory. It will be remembered that Massachusetts was one of the first states, nearly forty years ago, to undertake such a labor, which was accomplished as fully as the means of research then available would permit. It now proposes to take the initiative in a renewed investigation of the same character, to include a thorough examination into the fauna and flora of the state. It is to be hoped that this will be carried out, and that so worthy an example will be imitated by other states.

In concluding our notice of geographical operations in North America, we may refer in general terms to the labors of the United States Engineer Bureau, of which particular reference has been made in connection with the expeditions of Lieutenant Wheeler and Major Twining. Among the more prominent publications of the Bureau during 1874 are Maps of the Military Department of Missouri, embracing parts of Colorado, Kansas, Nebraska, and the Indian Territory; of the Ute country; New Mexico; the Military Department of the Platte; Nebraska; Wyoming; a general Military Map of the United States, showing the territories west of the Mississippi River; Chart of Lake Superior, in three sheets; Reconnoissance for a wagon road from the Pacific Railroad to Yellowstone Park and Montana, in fifty sheets; Maps of Sandusky Bay; St. Lawrence River; Lake St. Clair, and numerous charts of rivers and harbors in connection with river and harbor improvement, mostly upon the Great Lakes; as also a progress chart of survey of Northern and Northwestern Lakes, and a sketch of the complete triangulation in Wisconsin and Michigan.

The more important memoirs are a progress report of geographical and geological exploration, and surveys west of the

hundredth meridian in 1872; reports on the ornithological specimens and plants collected by Lieutenant Wheeler's expedition; the report of the Board of Commissioners on the irrigation of the San Joaquin, Tulare, and Sacramento valleys; report on the reconnoissance of the Ute country in 1872, made by Lieutenant Ruffner; the report on the Fort St. Philip Canal, and the construction of jetties for the improvement of the mouth of the Mississippi, etc.

Middle America.—The most important geographical and scientific exploration in Middle America is that which has been prosecuted in Costa Rica, under the direction of Professor William M. Gabb, formerly of the Geological Survey of California. This is under the auspices of the Costa Rican government, and has been undertaken for the development of the little-known Talamanca region occupying the southeastern corner of the territory.

Few enterprises of recent times have been more exhaustive and complete, with the means available, than that of Professor Gabb, since not only has the geological and mineralogical character of the country been determined, together with the topographical features, but exhaustive and complete collections have been made in botany and zoology. The latter have all been sent to the Smithsonian Institution for examination and report, and by their magnitude have excited much attention. Quite a number of new species of vertebrates and invertebrates have been detected, and there is little doubt that others will be noted in the progress of their examination.

Not the least of the work accomplished by Professor Gabb has been the collection of the vocabularies of the languages of the native tribes, and a large series of specimens illustrating their habits and characteristics, together with very large gatherings of prehistoric objects from the graves and other localities.

Mr. Osbert Salvin, whose name is well known in connection with zoological investigation in Guatemala and elsewhere, made a renewed visit a year or two ago to that country, from which he returned in the spring of 1874, with valuable notices tending to complete his previous publications in regard to the birds, mammals, and butterflies of Central America.

The question of the most suitable location for a ship canal across Middle America, whether by the way of the Isthmus of Tehuantepec, Nicaragua, or Darien, continues to attract the attention of the United States, thorough surveys over the three lines having been made by officers of the American Navy, and the results published by order of Congress. A government board is now in session, having for its object the discussion of the various routes, with a view of recommending for consideration that which shall be most practicable and desirable. A party has been again sent out by the commission for the purpose of obtaining some further data required before a definite conclusion can be reached.

South America.—Professor Hartt, during the past summer, made a fourth visit to Brazil, with a view of continuing the investigations previously conducted by him in regard to the geography, ethnology, and geology of this empire, and will probably remain long enough to add very much to our knowledge of the region. He expects to receive the sanction and support of the Brazilian government in his researches, which is, of course, more interested than the rest of the world in their accomplishment.

Professor Orton not long since returned from a second visit to South America, in the course of which he passed up the Amazon and across the continent to Pascamayo, on the Pacific, and thence down the coast to Lima, and up to Lake Titicaca by the new railway. His principal object was the exploration of the River Marañon and its tributaries. He is now about renewing his visit to South America, with a view of making himself acquainted with the character of certain little-known portions of Bolivia.

Mr. Alexander Agassiz left New York on the 21st of November for the purpose of spending the winter in Peru. It was his intention to make a special exploration of the waters of Lake Titicaca and its adjoining region, in the interest of the Museums of Comparative Zoology and of Ethnology in Cambridge. Much is to be expected from him, from his known energy and ability as an explorer.

A new survey of Paraguay has been undertaken under the leadership of Mr. Charles Twite, who is accompanied by Mr. Balzana and Mr. Keith Johnson as geographers.

The region of Terra del Fuego has also been explored

by a Chilian commission, accompanied by M. Pertuisset, a French savan.

Other surveys and examinations of more or less moment have been prosecuted by the various governments of South America, the results of which will doubtless in due time be presented to the world.

The Pacific Ocean and its islands, including Australia, New Zealand, New Guinea, etc., have constituted to a considerable extent a field of research during the year 1874, the most important labor being referred to under the head of deep-sea Explorations of the *Challenger* and of the *Tuscarora*. New ideas have been developed in regard to the configuration of the sea-bottom, its currents and its temperatures, and the dredge, the trawl, and the sounding-line have all been called into requisition in determining the condition of its animal life.

Various parties, destined for the observation of the transit of Venus on the 8th of December, have also traversed this ocean in various directions, and, as representing several prominent nationalities, accompanied by eminent specialists in almost every branch of science, we may expect a vast acquisition to our information. Their labors will have more special reference to the physical and natural history of the islands visited, including the Sandwich Islands, Campbell Island, the Marquesas, Auckland Islands, Japan, as also Kerguelen Island, Chatham Island, the Mauritius, and Rodriguez Islands, and of the Mascarenes and Saint Paul in the Indian Ocean. Advices have already been received from many of these parties, affording intimations of the results that we may reasonably expect hereafter.

The American vessel the *Swatara* was unable to land a party upon Crozet's Island, and probably this station will not be occupied by any one. Further information in regard to the astronomical parties will be found under the head of *Astronomy*. It may be remarked that the *Swatara* reached Hobart Town, the terminus of her voyage, on the 1st of October.

For some years past New Guinea has been a favorite field of research, Russian, Italian, German, English, and other parties having been engaged in its examination, among them Messrs. Beccari, De Albertis, Wallace, Michluco-Maclay, and

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Meyer. The real object of many of the expeditions has been the securing of new or rare species of birds-of-paradise, which are peculiar to this island, and which are eminent for their beauty, bringing enormous prices from fanciers.

Other explorations among the islands of the Pacific are referred to in a preceding notice of the operations of the U. S. Hydrographic Office and of the *Challenger*.

For **Asia**, we may refer to the labors of the Abbé David in the Yung-Ling Mountains, in the district of Maupin, China, this gentleman having continued those researches that have heretofore been so prolific in the discovery of new forms of animal life, and his renewed labors having brought to light many interesting forms of mammals and birds, most of them characterized by remarkable peculiarities as compared with the known species. Most of these were unfortunately lost by being wrecked in carrying them down to the coast. His examination of the River Hang-Kiang, in China, contrary to the former opinion in regard to it, shows that it is an important river of commerce, and traversed by vessels of large size.

Captain Prigiwolsky, of the Russian service, has also lately prosecuted explorations in the same region as that of Abbé David.

The Russian government has continued its usual work in the way of explorations in Siberia, and especially in the district of the Amu Daria, from which important geographical and scientific facts have already been derived. An examination of the Oxus has also been prosecuted.

The labors of the Geological Survey of India have been continued, and, as usual, been productive of important results both in geology and geography, although it has recently suffered a serious loss in the death of Dr. Stolickza, a paleontologist and naturalist.

The hitherto comparatively little-known regions about the sources of the Irrawaddy have been investigated by a party under the direction of the Emperor of Burmah.

Mr. J. B. Steere has made extended inquiries into the philology and natural history of the island of Formosa, in behalf of the University of Ann Arbor, Michigan. Complimentary reference is made by foreign journals to the extent and value of his labors.

Africa has, as usual, occupied a considerable share of the public attention, and the remaining problems in regard to her physical geography and general natural history are in a fair way of being solved. After the death of Dr. Livingstone, the special object of the British expedition under Lieutenant Cameron no longer existed, but it was concluded to utilize the opportunity of the party in conducting geographical exploration. So far, however, sickness in the party and the death of some of its members have interfered with the work, and it is not by any means certain that much is to be expected in the way of results.

Mr. H. M. Stanley, well-known in connection with his discovery of Dr. Livingstone's situation in Africa, has returned to that continent at the conjoint expense of the New York *Herald* and the London Daily *Telegraph*. At latest advices he was still at Zanzibar, preparing for his journey into the interior. He had, however, made some interesting explorations in the more immediate vicinity of Zanzibar, preliminary to his further work.

Nothing has been heard lately of the British expedition for the exploration of Western Africa, and along the region of the River Congo, under Lieutenant Grandy. A French party, under Messieurs Compiègne and Marche, has been working in the same direction, although the most important is, perhaps, that under the charge of the German African Exploring Society, of which the eminent Dr. Bastian, of Berlin, is president. It will be remembered that this party was wrecked on its first visit, although fortunately experiencing no loss beyond that of its instruments. These have been renewed, and considerable progress has been made in moving toward the interior.

The expedition by Gerhard Rohlfs and his companions, Dr. Zittel, Dr. Ascherson, and others, into the Libyan Desert, at the expense of the Khedive of Egypt, concluded its work, and returned to Cairo on the 17th of April, without meeting with that entire success which had been hoped for. The Oasis of Dakkel was thoroughly investigated, and other objects of interest well examined. The principal object of the mission, the Oasis of Kufarah, was not reached however. According to a communication from Dr. Schweinfurth to the British Association upon these oases, the first

mentioned is about two hundred and forty miles in length, and so formed as to resemble the bottom of a gigantic valley. As a whole, it is not uninterruptedly verdant, being of the usual monotonous yellow, but having about the springs black and green spots (or islands, as it were), forming the arable portions. The ten inhabited positions of the oasis are said to embrace 5700 inhabitants. In the village of Kargeh itself the houses are built over the streets, as on piles, and supported by rough beams, through which the people grope in a stooping posture. Their language is similar to that of the modern Egyptians, but the people are different, being apparently the remains of one of the numerous Libyan races of the Berber nations. Many remains of temples, castles, etc., testify to a former prosperity as compared with the present condition, and among these edifices are a number belonging to the period of the Roman occupation.

Water is obtained from wells of great antiquity, although it is probable that new ones might be had by Artesian boring, to the great advantage of the country. The springs are all thermal, registering much above the mean annual temperature of the year. The theory that the Nile originally flowed through this oasis is considered by Dr. Schweinfurth as unfounded, no fish being met with any where, and the botany of the country being totally opposed to such a conclusion. The principal production is the date-palm. The camel can not be kept here, owing to the damp summer miasma and the numerous irritating insects; but donkeys, cows, buffaloes, and sheep are easily reared. The explored portion of the oasis yielded two hundred and twenty-five species of plants.

Insuperable physical obstacles, in the way of shifting sands and the absence of water, met the travelers. Sixty camels were lost in this attempt.

Dr. Zittel, who accompanied Rohlfs as geologist, in his researches, is quite satisfied that the Sahara, as already suggested, is the dried-up basin of a former shallow sea. The very fine quartz sand found here is not produced from any formation in or near it, and must have been carried to it by some foreign agency. The real surface of the desert is a bare, dry, chalk plateau, resembling that of the Suabian Alps. Above it rise peaks, which are, however, on the same level, and show that they are the remains of an ancient surface, the

intervening spaces of which have been washed away, possibly by the action of waves upon it. Numerous splinters of flint have been found about certain peaks, produced by the cutting process of the alternate slight dews and frosts which are known in the winter nights of the Sahara.

The project of converting a portion of the Sahara Desert into an inland sea continues to find favor, and it is understood that thorough surveys with a view to determine the precise mode of accomplishing this object are under way by the French government. As to whether the result aimed at is desirable or not is at present a question of considerable discussion. On the one hand, the replacing of a large amount of desert waste by water, and making sea-ports of interior points in Algeria, and the expected restoration of an ample rain-fall to various parts of Northern Africa, are viewed with favorable anticipations. On the other hand, it is maintained that the sea will be simply an immense evaporation basin, which will soon be clogged up with salt; or that a serious interference will take place in the amount of heated air carried across the Mediterranean, and which at present prevents the extension of the Alpine glaciers. Should this be interrupted, it is feared that increased glaciation will ensue, possibly restoring a large portion of Central Europe to its condition during the reindeer epoch. Whatever be the result of this great engineering operation, it is extremely probable that it will be attempted by the French authorities.

It is understood that Captain Roudaire, the originator of the enterprise, has lately proceeded to the locality referred to for the purpose of making a more thorough survey of the region.

The Khedive of Egypt, in carrying out various measures for the development of the resources of his country, has organized an expedition to survey the physical and geological formations of the Valley of the Nile and the countries adjacent to the Red Sea. The project has been formed of directing the waters of the Nile into the bed of the ancient river that formerly flowed through the valley, and which is still called by the Arabs the Valley of the Dry Nile. One object of the expedition is to determine whether this be feasible; as, if so, it may result in the reclamation and cultivation of vast tracts of land now desert and sterile.

MICROSCOPY.

Objectives.—Professor Ruell Keith, of Washington, has discussed the formula of an immersion objective made by Tolles, of Boston, and proves that it has a greater angle than corresponds to the maximum possible for dry objectives. The extreme aperture in fluid balsam, no allowance being made for the setting of the small front lens, is 110° 35′; or, allowing 0.00162 for the setting of the front lens, the aperture is reduced to 87°. The objective was composed of seven lenses, and had an equivalent focus of one tenth of an inch.

In the *American Naturalist* for July, 1874, Mr. George W. Morehouse gives a somewhat extended account of the marvelous performance of a one fiftieth of an inch objective made by Mr. Tolles. The most severe tests were easily resolved, and the lines of *Amphipleura pellucida* shown as rows of dots.

The Boston *Journal of Chemistry* announces that Mr. Tolles has alone made an objective one seventy-fifth of an inch; but that journal is evidently unaware that Messrs. Powell & Lealand have long since achieved a similar result. The power of this objective is such that a single white corpuscle of the blood covers the entire field of vision.

Mr. Henry J. Slack speaks very favorably of the recent objectives made by Zeiss, of Jena; especially of his low-priced one-sixth inch. Zeiss makes three immersion glasses, the real angles of which, for water, are, as he states, between 104° and 108°; whereas theory and practice agree in assigning an angle of 105° as the limit that may not be exceeded in dry systems without rendering the correction of spherical aberration impossible, or reducing the working distance so that the systems become exceedingly troublesome to use—an angle of 97° for water would imply an angle of 180° in air.

The objectives of L. Benéche, of Berlin, are very highly spoken of by Mr. W. J. Hickie, the one-fourth inch resolving *P. angulatum* with direct light, and without a condenser, in the most satisfactory manner; and with oblique light easily resolving *Surirella gemma*.

Microscopical Apparatus.—The Holman Siphon Slide, as exhibited by Dr. Richardson at the Microscopical Section of

the Academy of Natural Sciences, Philadelphia, consists of a strip of thick plate-glass, in the upper surface of which is a shallow groove, deeper toward one extremity, and so arranged as to receive a small fish, tadpole, or triton, and retain it without injury. The great improvement of this slide consists in imbedding a small metallic tube in either end of the slide, and the adaptation to these tubes of slender caoutchouc pipe, one intended for the entrance and the other for the exit of any fluid, cold or hot. The animal can thus be kept for hours, or days, the fluid flowing through as in any siphon.

A simple and easily made cell is described in the *Quarterly Microscopical Journal* for studying the development of the *Mucoridine*. It is made by cementing a glass ring, three to five millimeters in height, to a glass slip with Canada balsam. The sporules of the fungus are placed on a slip, or cover of thin glass, and a drop of nutritive fluid placed on them; a little water having been spread over the bottom of the cell, the cover, having on it the spores and nutritive fluid, is lowered into its place, the drop, of course, being clear of the floor of the cell, but in a damp atmosphere. If required to be kept for some time, the covers may be attached by a drop of oil, and the whole suspended in a pan containing moistened sand. The nutritive fluid recommended is orange-juice, boiled and filtered; and which, from its acid, saccharine nature, appears to be admirably adapted for the growth of many fungi.

Professor T. D. Biscoe has contrived a new section cutter, adapted for preparing sections of leaves, buds, etc. It consists essentially of a large glass stage plate, upon which the object is fastened, and a movable frame to slide upon this, carrying a razor-blade at an adjustable distance from the plate. The sections are cut under observation, on the stage of the microscope. It is fully described and figured in the *American Naturalist*.

A Spherical Diaphragm is described in the *American Naturalist* by Mr. F. B. Kimball. He says: "I made a globe one and one fourth of an inch in diameter, and drilled holes through it of proper grades and sizes; the ball is revolved upon its axis by means of a milled head at the right of the stage. It presents many advantages over the ordinary

piece of apparatus; the largest hole might easily be made to receive a tube, for an achromatic condenser or a polariscope."

Cements, Staining Fluids, and Cells.—A cement possessing the advantage that it can be used under water, or weak spirit, so that the cover can be affixed under the surface of the fluid, is highly spoken of by Mr. George Busk. It is termed "caoutchouc size," and is prepared by melting pieces of caoutchouc in a cup until it is reduced to a viscid tar, which is to be dissolved in benzine to the consistency of thick gold-size. When spread over the edges of the cell, it should be allowed to dry for a quarter or half an hour, until the benzine has evaporated. The cell with its contents may then be wholly immersed, and the cover applied and pressed firmly in its place; all air-bubbles are thus avoided. When the surfaces are dry, a solution of shellac, or other varnish, will complete the mounting.

Mr. T. Charters White recommends to the Queckett Club a cement consisting of four or five parts of common yellow beeswax, melted with one part of Canada balsam; it is applied melted, on a hot wire, after the manner of soldering; sets as soon as cool, and hence can not run in under the cover, however thin the cell may be; and can be instantly loosened by warming, if the cell is to be repaired or the object dismounted.

Mr. Henry F. Hailes contributed to the Queckett Club a valuable application of the sand-blast process. It occurred to him that this process might be employed to sink cells in glass slips for microscopic mounting; and they are now to be had for this purpose. They can be sunk of any desired size or shape; and although the surfaces are rough, or ground, this is not a disadvantage. For opaque objects it forms an agreeable background; and for objects in balsam, since the refractive power of this medium is so near that of glass, it disappears. These cells are particularly available for Foraminifera.

The following method is recommended as a remedy for the uncertainty that exists in the conservation of such objects as are usually mounted in cells with fluid.

Soak a few pieces of gelatine in water for about twelve hours. Having cleaned the glass slip, place a small piece

of the softened gelatine in the centre of it; now place the confervæ, or other object (previously dried as far as possible), on the gelatine, and gently warm over a lamp, simply to melt the gelatine—no more. The object having been arranged, and the gelatine made to spread out as a thin sheet, set the slide aside to cool. When cold, place a drop of balsam thinned with benzole on the gelatine, warm the covering glass, place it over the object, squeezing out the superfluous balsam, and set aside to dry.

Mr. W. H. Jackson describes a new aniline staining fluid which appears to have many advantages. He says: Prepare a strong solution of tannic acid in water, dissolve a little crystallized magenta in water in a test tube (or add Judson's magenta to water). Both solutions must be cold. Add the tannic acid drop by drop to the magenta, shaking the test tube after adding each drop, and taking care not to precipitate the magenta entirely. Let the precipitate settle; pour off the fluid, and wash the precipitate by decantation several times with cold water. Finally, let it partially dry, and add just a drop of acetic acid, and then alcohol drop by drop till it dissolves. The solution is pink. The following preservative solutions, in mounting specimens stained by this dye, are recommended. Both are made from sugar, and consist of strong sirup, to which is added, to form solution A (while hot), three to four per cent. of sodium chloride; and to form solution B, the same quantity of calcium chloride: the latter is practically uncrystallizable, whereas the former crystallizes with difficulty. If a section, after staining, be immersed in cold water, it sets the dye, and the section may be mounted in either of these fluids, and will remain unchanged.

Dr. Christopher Johnson recommends for blue and violet stainings of vegetable tissues a dilution of the hæmatoxyline staining fluid of Dr. J. W. S. Arnold, of New York, and also an aqueous solution of aniline blue, made and labeled "blue ink" by F. G. Bower & Co., New York. Arnold's fluid is prepared by finely pulverizing logwood extract, and adding about three times its bulk in powdered alum; the two ingredients are well rubbed together with a small quantity of distilled water: fifteen or twenty minutes' vigorous trituration will be necessary for a thorough incorporation; water

is now added, and the solution filtered. It should present a clear, dark-violet color; if, instead of this, it is dirty red, more alum must be incorporated. This fluid colors very rapidly, and will not wash out; but the aniline blue will do so unless precaution be taken.

The picro-carminate of ammonia, invented by M. Ranvier, stains tissues in several colors, varying from a bright red to an intense yellow. In the *epidermis*, for example, it distinguishes three layers:

I. Superficially the horny-layer, consisting of flattened cells: *intense yellow*.

II. An intermediate layer, cells filled with granules: *bright red*.

III. A layer of cells under this, colored *dull yellow*, with their *nuclei* stained *red*.

The picro-carminate is made by mixing—

Carmine (best)	1 gramme.
Liq. Ammoniæ	4 cub. centimeters.
Water	200 grammes.

Add to the mixture five grammes of picric acid; agitate and decant; the liquor is to be left several days, and agitated from time to time; it may then be evaporated to dryness, and the red powder kept for use. The liquid is made by dissolving two parts of powder in one hundred of water, and filtering; to prevent fungi, a few drops of carbolic acid may be added.

News of Bathybius.—The continual references in zoological writings to this interesting structure make it desirable to record the latest information that has come to hand bearing upon this supposed organism. It must be remembered that the *Bathybius* of to-day is not Huxley's *Bathybius*, but Haeckel's. Professor Huxley suggested the association of coccoliths and coccospheres with the albuminoid slime, which he clearly demonstrated to exist in specimens of Atlantic ooze, and which gives to that ooze a peculiar glairy character. Professor Haeckel removed the coccoliths from association with this albuminous material, showing that they were either formed in a Radiolarian frequenting the surface, or were independent surface organisms taken as food *near the surface* by that Radiolarian. There remained, then, the al-

buminous ooze-cement, which Professor Haeckel still considered as a definite organism, and of which he gave some drawings in the form of net-works derived from the study of Atlantic ooze preserved in alcohol. *Bathybius* now became a very suggestive subject for investigation, but could not be admitted as a satisfactorily established independent organism. The deep-sea explorations of the *Lightning* and *Porcupine* brought no news of it. Professor Wyville Thomson, in his "Depths of the Sea," is exceedingly cautious in dealing with it. He speaks of "the viscid streams" of *Bathybius*, and also of its movement, but not that he himself has seen it; and he states that he is by no means satisfied that *Bathybius* is the permanent form of any living being. From the *Challenger* we hear that one of the naturalists, who has paid great attention to the ooze, finds the Globigerina mud full of the pseudopodia of that foraminifer. When alcohol is added to this, the pseudopodial matter is precipitated, and this is what is figured by Haeckel as *Bathybius*. A similar precipitate may be obtained from living specimens of the Foraminifera. So far the prospect is not very hopeful for *Bathybius*. The subject is now being investigated by Professor E. van Beneden.

During the cruise of the *Challenger* in the Antarctic Ocean special attention was paid by Mr. Murray to the nature of the bottom. He was induced, by the observations that have been made in the Atlantic, to combine the use of the towing net at various depths from the surface to one hundred and fifty fathoms, with the examination of the samples from the soundings. And this double work has led him to the conclusion (in which Sir W. Thomson is forced to concur, although contrary to his former opinion) that the bulk of the material of the bottom in deep water is, in all cases, derived from the surface; this, if it be proved a fact, will suggest important modifications of our opinions in regard to general geological conditions and formation of sedimentary strata. The absence of Foraminifera and other calcareous organisms at depths of about 1500 fathoms, noticeable also in the soundings of the United States steamship *Tuscarora* in the Pacific, is explained by Sir W. Thomson by the fact, as appears from observation, that the deeper strata are rich in carbonic acid, this forming more than one third of the gaseous com-

ponent of the water; this, with the pressure exercised, causes a rapid solution of carbonate of lime, leaving a homogeneous red mud, which in the Pacific soundings is always highly charged with *Polycystinæ*.

A new amœboid organism from fresh-water was described by Dr. Greef, under the name of *Pelobius*, intended as a pair to *Bathybius*. This name was already in use for an insect, and he now proposes *Pelomyxa*, and he figures it in three plates. The masses are large, dark brown in color, and protruding lobose hyaline pseudopodia.

What is a Sponge?—This seems a more difficult question than ever. Haeckel has recently confirmed, in a great measure, Mr. Carter's view, that it is a collection of amœba-like infusoria. Professor H. J. Clark published in 1866 a paper in which he maintained that the sponge was an aggregation of flagellate infusoria, a compound protozoan animal. Haeckel contends that the monads of Clark are simply cells, lining the general stomach-cavity of the sponge; and that the sponge is not a compound infusorian, but a much more highly organized animal, allied to the radiates; and he regards the sponges and acaléphæ as evolved from a common ancestor, which he terms *Protascus*.

In the April and July numbers of the *Quarterly Journal of Microscopical Science* Professor Wright commences a translation of Ernst Haeckel's "Gastrea Theory." It is a remarkable paper, and will be closely studied by those interested in the question of development and descent. This name, "Gastrea," was first applied by Haeckel, in his "Philosophy of the Calcareous Sponges," to what he considers the primitive root form, long extinct, which existed in the earlier primordial time (Laurentian period), represented, therefore, by the *Eozoon Canadense*. This theory is a bold attempt at a fundamental remodeling of the whole system of zoology, and is, it is claimed, the first attempt to lead to a causal knowledge of the most important morphological relations, and the principal typical differences in the structure of animals, as well as at the same time to discover the historical sequence of the origin of the animal organization. Inheritance and adaptability are the only "two mechanical causes" with the help of which the gastrea theory explains the origin of the leading natural groups of the animal

kingdom, and the characteristic relations of their organizations.

"Researches on the Life History of a *Cercomonad*" is the title of a capital paper by Mr. W. Dallinger and Dr. Drysdale, a lesson in biogonesis which can be commended. They show that the new cercomonad, when mature, multiplies by fission for a period extending from two to eight days. It then becomes amœboid: two individuals coalesce, increase in size, and become a distended cyst, which eventually bursts, discharging incalculable hosts of immeasurably small sporules; which slowly enlarge, acquire flagella, become active, and rapidly attain the parent form. They prove also that the granules can withstand a much higher temperature than the mature forms.

Professor Leidy, noticing the enemies of *Difflugia*, says: "I have repeatedly observed an *Amœba* with a swallowed *Arcella*, but never with a *Difflugia*. Worms destroy many of the latter; and I have frequently observed them within the intestine of *Nais*, *Pristina*, *Chætogaster*, and *Æsolosoma*. I was surprised to find that *Stentor polymorphus* was also fond of *Difflugia*. On one occasion I accidentally fixed a *Stentor* by pressing down the cover of an animalcule cage on a *Difflugia* which it had swallowed. The *Stentor* contracted, and suddenly elongated, and repeated these movements until it had split three fourths of the length of its body through, and had torn itself loose from the fastened *Difflugia;* nor did the *Stentor* suffer from the laceration of its body, for in the course of several hours each half became separated as a distinct individual.

The following experiments were made by Professor Leidy on the *Revivification of Rotifer vulgaris:* Two glass slides, containing, beneath cover glasses, each about a dozen living rotifers, were placed on a window-ledge, the thermometer being at 80°, and allowed to dry. The next morning, about twelve hours after the drying, water was applied, and the slides examined; the dried rotifers imbibed the water, and expanded; and in the course of half an hour revived, and exhibited their usual movements, though some remained motionless. The same slides were again dried, and examined the next day; only two, after moistening, were noticed moving on each slide. He next submitted a slide, upon which

there were upward of twenty active rotifers, to a hot sun, during an afternoon; after moistening the material, all continued motionless. From these observations, it appears that when the animals are actually dried, they are incapable of being revivified.

The name of *Ouramœba* is proposed by Professor Leidy for a fresh-water rhizopod, allied to *Amœba*, but distinguished by tufts of tail-like appendages or rays, which are rigid and coarse compared with those of *Actinophrys*. He describes two species.

According to Mr. Hawkins Johnson, thin sections of flint, and iron pyrites of the chalk, also of septaria and clay ironstone nodules, all exhibit, after proper treatment with acid, a structure apparently consisting of fibres ramifying in all directions, the organic character of which can scarcely be doubted.

The Eozoon Controversy.—The debate as to the organic origin of this object has been again revived, through an article in the *Annals and Magazine of Natural History*, by the well-known authority H. J. Carter. An abstract of this paper may be found in the July number of the *Monthly Microscopical Journal*. In the April number of the *Annals*, Dr. Carpenter returns to the charge, and writes what we consider to be the best and clearest article he has yet given on the subject. After perusing Dr. Carpenter's paper, it is difficult to turn away the conclusion that *Eozoon* was a true foraminifer, abnormal in many respects, but not more so than the *Parkeria* of the greensand. In the same number is an abstract of a paper by Professor Max Schultze on the *Eozoon Canadense*, in which that celebrated microscopist gives the result of his own examination of original specimens; and the conclusion he has arrived at is that there can be no serious doubt as to the foraminiferous nature of *Eozoon*.

Mr. George W. Morehouse, in an excellent article upon the markings of the Diatomaceæ under high powers, in the *American Naturalist* for May, arrives at the conclusion that the perfect box-like form and elaborate ornamentation exclude the idea of a blind process of chemical crystallization, referring, we suppose, to Max Schultze's so-called "Artificial Diatomaceæ," and Mr. Slack's experiments with silica films. He is wrong, however, as to the silicious build of the frus-

tule according to its environments: it is by no means the case, as stated by him, that those contained in gelatinous envelopes are less developed in strength of shell and bracing; for example, *Encyonema prostratum* is an exceedingly stout form, and contained in remarkably stout tubes, while *Fragilaria striatella*, attached to algæ in running brackish water, is so feebly silicious that it will not stand acid treatment at all. Closely connected with microscopic examination of markings and structure of diatoms, we may notice the result of Professor Abbe's researches, published in a late number of Max Schultze's *Archiv*. He arrives at the conclusion that the limit of capability is almost reached by our best microscopes, and that all hope of a deeper penetration into the material constitution of things than such microscopes now afford must be dismissed, experiment and theory both showing that the changes wrought by diffraction, in the examination of very minute structures, are such that different structures may give the same microscopical image, or like structures different images.

Blood.—The origin and development of the colored corpuscles is stated by Dr. D. H. Schmidt, of New Orleans, so far as the human embryo is concerned, to be sought in the gland-like follicles of the umbilical vesicle, differing of course entirely, as he admits, from the older observations, as also from the later, of Klein and those of Balfour.

In a paper read before the Biological and Microscopical Section of the American Academy of Sciences, Dr. Joseph J. Richardson states that we are now able, by the aid of high powers of the microscope, and under favorable circumstances, to positively distinguish stains produced by human blood from those caused by the blood of any of the ordinary domestic animals; and this even after a lapse of five years from the date of their primary production.

It is now pretty generally agreed that bacteria are almost invariably present in the blood, but Dr. Eberth (in *Centralblatt*, No. 20, 1873) has found them in ordinary perspiration; in spots covered with hair they attach themselves to the hair, often forming thick layers. He thinks they are very likely to produce certain chemical modifications of sweat.

Careful microscopic examination has shown that caries in

teeth is largely due, not merely to the acids of the mouth, but to a vegetable parasite, *Leptothrix buccalis.* Besides this, there are other vegetable and even animal growths; these are not much affected, except as to their abundance, by the ordinary means employed to clean the teeth, but soapy water appears to destroy them. The fungus attains its greatest size in the interstices of the teeth, and after the action of acids, taken with the food or in medicines, or such as are formed in the mouth itself by some abnormality in the secretions, which make the teeth more or less porous or soft, the fungi penetrate the canaliculi both of the enamel and of the dentine, and by their proliferation produce rapid softening and destructive effects.

Dr. Lester Curtis states that Conheim's conclusion that the pus corpuscle and the white blood corpuscle are identical, even with the saving epithet *morphologically*, is inconsistent with well-known facts. It is due partly to the acceptation of this theory that the name "*leucolyte*" has arisen—a term applied indiscriminately to the white blood corpuscle, the lymph corpuscle, the wandering cell, and the pus corpuscle. He attempts to prove—1st. That white blood corpuscles, being in a transition stage, we have no right to expect that in the changed condition of nutrition to which they are subjected outside the vessels they would continue to be the same that they were within the vessels. 2d. That mere similarity of appearance was not sufficient evidence of identity. 3d. That different samples of pus are unlike each other; which they would not be if they were white blood corpuscles. 4th. That pus differs from white blood corpuscles—(*a*) in the disturbance it sets up when introduced in these vessels; (*b*) in the loss of power of organizing; (*c*) in the frequent acquisition of contagious properties.

We find in the *Medical Record*, July, 1874, an account of two cases of the fatal malady called malignant pustule, and known, when occurring in cattle, as "the blood," and to which the French give the name *Charbon*, and the Germans that of *Milzbrand.* A microscopic examination showed in the blood, and in the greenish-yellow spots, and in the parenchyma of the gastric walls, enormous quantities of bacteria; the disease was communicated from the first patient to the *post-mortem* assistant of the hospital, and both cases

were fatal. Subsequently, Dr. Orth inoculated a rabbit with the fresh blood of the second case, and from this one another, and so on till eight were injected. Masses of bacteria were found in the blood and connective tissue of all these animals.

In the May number of the *Monthly Microscopical Journal* we find an interesting communication from Dr. D. H. Schmidt, of New Orleans, on "The construction of dark or double-bordered Nerve Fibre;" the paper is illustrated by three plates, and upon the whole confirms Max Schultze's discovery of the fibrillous structure of the axis cylinder, differing, however, in this, that whereas Schultze considered the fibrils *smooth*, Schmidt finds them to consist of *minute granules* about $\frac{1}{1200}$ millimeter in diameter, arranged in regular rows, and united by a homogeneous inter-fibrillous substance. One is reminded of Mr. Slack's resolution of the hitherto considered smooth pinnæ of *Pinnularia* into a granular structure, and also of Dr. Pigott's "Podura beads." All these appearances are produced by the use of extreme oblique light, and we are by no means convinced that they indicate the true structure.

ETHNOLOGY.

Progress in *Anthropology* and *Ethnology* has been in three directions:

1. There has been a more thorough and systematic method of observation on the field, a more scientific classification of the material, and a multiplication of societies and periodicals for the purposes of study and popular instruction.

2. A great increase has taken place in the number and thoroughness of investigations in drift gravels, caves, palafittes, kjökkenmöddings, mounds, tumuli, shell-heaps, and among the ruins of buried cities, etc.

3. Our knowledge has been greatly extended of the tribes of men now living on the earth, whose structure and objects of culture throw light upon the history of mankind, in all ages of the world and in all conditions of society.

An interesting lecture on anthropology, by Dr. G. Thanlow Kiel, appears in *Zeitschrift für Ethnologie*, setting forth the design and scope of the orders issued to officers of the Navy by the chief of the German Admiralty, at the instance of the

Berlin Society of Anthropology, Ethnology, and Prehistoric Archæology, instructing them as to collections to be made in all parts of the world.

Professor Busk, in Vol. III. of the *Journal of the Anthropological Institute*, figures and describes a new and handy chorometer. A discussion upon the material for testing the cubical contents of skulls accompanies the report.

In the same journal, January 27, 1874, Dr. H. von Jhering and Dr. Paul Broca make valuable contributions to the methods of craniometry. The latter, in the *Bulletin de la Société d'Anthropologie* (Paris, Part I., 1874), describes and figures instruments for examining the cranial cavity without sawing the skull.

At the Bradford meeting of the British Association, held September, 1873, a committee, consisting of Colonel Lane Fox, Dr. Beddoe, Mr. Franks, Sir J. Lubbock, Bart., Sir Walter Elliot, Mr. Clements R. Markham, and Mr. E. B. Tylor, reported through Colonel Lane Fox, their chairman, upon "Instructions for Travelers, Ethnologists, and other Anthropological Observers," that they had met and passed the following resolutions:

"1. That the work to be published by the committee shall consist of numbered sections, each section being prefaced by a few lines of explanatory notes and followed by questions.

"2. That the notes and questions shall be as brief as possible.

"3. That the secretary be requested to draw up the headings of about one hundred sections, and submit them to the committee at their next meeting.

"4. That the secretary be requested to draw up a specimen section or sections upon half margin, and to circulate them among the members of the committee for their remarks previously to the next meeting of the committee.

"5. That the title of the work shall be, 'Notes and Queries on Anthropology, for the Use of Travelers and Residents in Uncivilized Lands.'

"6. That M. Broca's chromatic tables be adopted; and that Dr. Beddoe be requested to communicate with him for the purpose of ascertaining in what manner they can be most economically reproduced in this country."

The following is a list of the sections:

Part I.—Constitution of Man.

1. *Measuring Instruments*; 2. *Form and Size*; 3. *Anatomy and Physiology*; 4. *Development and Decay*; 5. *Hair*; 6. *Color*; 7. *Odor*; 8. *Motions*; 9. *Physiognomy*; 10. *Pathology*; 11. *Abnormalities*; 12. *Physical Powers*; 13. *Senses*; 14. *Heredity*; 15. *Crosses*; 16. *Reproductions*; 17. *Psychology*.

Part II.—Culture.

18. *History*; 19. *Archæology*; 20. *Etymology*; 21. *Astronomy*; 22. *Arithmetic*; 23. *Medicine*; 24. *Food*; 25. *Cannibalism*; 26. *Narcotics*; 27. *Crimes*; 28. *Morals*; 29. *Fetiches*; 30. *Religion*; 31. *Superstitions*; 32. *Witchcraft*; 33. *Mythology*; 34. *Government*; 35. *Laws*; 36. *Customs*; 37. *Labor*; 38. *Property*; 39. *Trade*; 40. *Money*; 41. *Weights and Measures*; 42. *War*; 43. *Hunting*; 44. *Nomadic Life*; 45. *Pastoral Life*; 46. *Agriculture*; 47. *Training Animals*; 48. *Slavery*; 49. *Social Relations*; 50. *Sexual Relations*; 51. *Relationships*; 52. *Treatment of Widows*; 53. *Infanticide*; 54. *Causes that Limit Population*; 55. *Education*; 56. *Military Ceremonies*; 57. *Games*; 58. *Communications*; 59. *Tattooing*; 60. *Clothing*; 61. *Personal Ornaments*; 62. *Burials*; 63. *Deformations*; 64. *Tribal Marks*; 65. *Circumcision*; 66. *Totems*; 67. *Dyeing*; 68. *Music*; 69. *Language*; 70. *Poetry*; 71. *Writing*; 72. *Drawing*; 73. *Ornamentation*; 74. *Machinery*; 75. *Navigation*; 76. *Habitations*; 77. *Fire*; 78. *String*; 79. *Weaving*; 80. *Pottery*; 81. *Leather-work*; 82. *Basket-work*; 83. *Stone Implements*; 84. *Metallurgy*; 85. *Miscellaneous Arts and Manufactures*; 86. *Memorial Structures*; 87. *Engineering*; 88. *Topography*; 89. *Swimming*; 90. *Natural Forms*; 91. *Conservatism*; 92. *Variation*; 93. *Invention*.

Part III.—Miscellaneous.

94. *Population*; 95. *Contact with Civilized Races*; 96. *Preserving Specimens*; 97. *Anthropological Collections*; 98. *Casts, etc.*; 99. *Photography*; 100. *Statistics*.

In pursuance of the same general object, the French Anthropological Society has issued a volume of "Instructions sur l'Anthropologie de l'Algérie," by General Faidherbe and

Dr. Topinard. Special attention is to be directed to the origin, anthropological characters, language, and geographical distribution of the races, and to any particular customs or beliefs.

There appears to be a general movement among ethnologists toward a better arrangement of the great mass and variety of material which has been gathered at different times from so many fields. Discarding the thought that a museum should consist merely of bizarre specimens, so arranged as to astonish the laity, they have decided to dispose the objects with regard to education and convenience of research. Looking upon humanity as a unit, and assuming that its movement has been, on the whole, onward and upward from a state of primal inexperience, they regard an ethnological museum to be a collection of such material as will illustrate all parts of the subject, so arranged as to exhibit the various stages in that progress. Wachsmuth and Klemm, of Germany, laid the foundation of this classification; and the system of arrangement was followed out in the splendid collection of the latter, which has now passed into the possession of the "Leipsic Central Museum of Ethnology."

Discarding the disposition of material adopted by Sir R. Wilde in the Royal Irish Museum, and the arrangement according to tribes in the Moscow and other museums, they have divided the objects, embracing original matter, casts, drawings, models, photographs, and a library, into anthropological and culture-historical, and these again into prehistoric and historic. The historic objects of culture are embraced in sixteen classes; viz., food, fire, weapons, tools, clothing, ornament, vessels, dwellings, games, traveling equipments, music, sacra, fine arts, writing, weighing and valuing, public life and sociological phenomena.

NOTES ON CLASSIFICATION.

Dr. Forbes Watson lately read a paper before the "International Congress of Orientalists," in which the following plan of arranging the "Indian Museum" and "Library of London" was reported:

A. The Country and its Resources.

I. PHYSICAL GEOGRAPHY.

- *a.* Boundaries and Administrative Divisions.
- *b.* Orography.
- *c.* Hydrography.
- *d.* Meteorology.

II. NATURAL HISTORY.

- *a.* Geology and Mineralogy.
- *b.* Soil.
- *c.* Flora.
- *d.* Fauna.

III. AGRICULTURE, MANUFACTURES, AND COMMERCE.

- *a.* Raw Material, Mining, Agriculture, Forestry, etc.
- *b.* Trade and Manufactures.
- *c.* Tools, Machinery, and Processes.
- *d.* Locomotion by Land and Water.
- *e.* Harbors, Light-houses, Docks, Warehouses, Fairs, Markets, Telegraph, and Postal Communications.
- *f.* Currency, Banks, etc.
- *g.* Coins, Weights, Measures.

B. The People and their Moral and Material Condition.

IV. ETHNOGRAPHY.

- *a.* Races.
- *b.* Castes and Religious Sects.
- *c.* Population and Vital Statistics.

V. HISTORY AND ADMINISTRATION.

- *a.* Philology.
- *b.* Archæology.
- *c.* Mythology.
- *d.* Historical Geography.
- *e.* Political Administration.
- *f.* Legislation.
- *g.* Current Administration.

VI. DOMESTIC AND SOCIAL ECONOMY.

- *a.* Food and Cooking.
- *b.* Houses and Buildings.
- *c.* Clothing and Personal Decoration.
- *d.* Manners and Customs.
- *e.* Health and Sanitation.
- *f.* Education.
- *g.* Religion.
- *h.* Fine and Decorative Art.
- *i.* Science and Literature.

But by far the most elaborate effort at classification is by Colonel Lane Fox, of London, an account of which is to be found in the journal of the United Service Institution. At a special meeting of the Anthropological Institute, in the East London Museum, Bethnal Green, July 1, 1874, Colonel Lane Fox read a paper on the principles of classification adopted in the arrangement of his anthropological collection there on exhibition. The paper contains three divisions—Psychological, Ethnological, and Prehistoric. The author's primary arrangement has been guided by *form*, *i. e.*, spears, bows, clubs, etc., have been placed in distinct classes; within each class there are sub-classes for special localities, and in each of the sub-classes the specimens are arranged according to affinities. It was shown how far the arts of existing savages might be employed to illustrate the relics of

primeval man. In studying the evidences of progress, the phenomena which might be observed were (1) a continuous succession of ideas, (2) the complexity of the ideas in an increasing ratio to time, (3) the tendency to automatic action upon any given set of ideas in proportion to the length of time during which the ancestors of the individuals have exercised their minds in these particular ideas. Colonel Fox pointed out that the forms of implements used by savage tribes, instead of affording evidence of their having been derived from higher and more complex forms, showed evidence of derivation from natural forms, such as might have been employed by man before he had learned the art of modifying them to his own use; and that the persistence of the forms is in proportion to the low state of culture. The third and concluding part of the paper is devoted to the correlation of modern implements in use among existing savages with those of prehistoric times.

Dr. Charles Rau, of New York, says: "Anthropology is now the favorite and fashionable study in Europe. Not only savans, but also liberally educated people of all classes join in these interesting pursuits." In almost every Association for the Advancement of Science there is an anthropological section, whose reports are made in the general volumes. Anthropological societies, general and local, publish journals and proceedings. First-class literary papers keep us posted on the meetings of these bodies, and on the latest discoveries. Popular magazines have a corner for notes on the subject, and even sensational journals are working up the story of prehistoric times. We can do no more in this number of the *Record* than to draw attention to the principal sources of information.

The seventh session of the International Congress of Anthropology and Prehistoric Archæology was held at Stockholm on the 7th of August. Count Henning Hamilton was chosen president. Among the questions discussed were: "What are the earliest traces of the existence of man in Sweden?" "Can the precise way in which the trade in amber was carried on in early times be pointed out?" "What characterizes the age of polished stone implements in Sweden; and can the remains of this age be referred to a single race, or are we to suppose that several peoples were inhabit-

ing Sweden at the same time?" "The origin and history of the Bronze Age in Sweden?" "The Iron Age in Sweden?" "Björkö, and other old prehistoric towns of Sweden and other parts of Europe?" "What are the anatomical and ethnical features peculiar to the prehistoric man in Sweden?" The association numbers 1550 members, of which nearly half were present. The next meeting will be held at Buda-Pesth. H. H. Howorth, Esq., read a report on this Congress before the Anthropological Institute, November 10, 1874.

The International Congress of Orientalists met in London from the 4th to the 19th of September. Dr. Birch was chosen president. The most noticeable features of the meeting were the opening addresses of Sir Walter Elliot before the Turanian Section, of Professor Max Müller, before the Aryan Section, of Mr. Grant Duff, before the Archæological Section, and of Professor Owen, before the Ethnological Section; and the papers of Herr Brugsch Bey, before the Hamitic Section, on the Exodus of the Israelites; and those of Professors Oppert and Schrader, before the Semitic Section, on the Sumerian or Accad, the language of ancient Chaldæa. Mr. Hyde Clarke read a report on the ethnological papers of this Congress before the Anthropological Institute, November 10, 1874.

The British Association meeting at Belfast, commencing August 9th, was not unmindful of the subject of ethnology, although the meeting at Stockholm drew away a great many of the members of that section. F. W. Rudler, Esq., made a report of the ethnology of this meeting, November 10, 1874, to the Anthropological Institute.

The following are a few of the prominent local associations which contribute to knowledge on the subject of ethnology:

AMERICA: The Peabody Museum of American Archæology and Ethnology.
The American Ethnological Society.
The American Oriental Society.
The Smithsonian Institution.
The Palestine Exploration Society.

EUROPE: The Imperial Society of Friends of Natural Science, Anthropology, and Ethnography.
The Anthropological Society of Sweden at Stockholm.
Ethnological Museums at Stockholm and Lund.

EUROPE: The Society of Northern Antiquaries of Copenhagen.
Museums at Copenhagen, Flensburg, and Aarhuus.

The Anthropological Institute of Great Britain and Ireland.
The London Society of Antiquaries.
The Royal Asiatic Society, London.
The Royal Geographical Society, London.
The Society of Biblical Archæology, London.
The British Museum.
The Blackmore Museum, Salisbury.
The South Kensington Museum.
The Edinburgh Museum.
The Royal Irish Museum, Dublin.

The Société d'Anthropologie de Paris.
The Société Orientale de France.
The Société de Geographie de Paris.
Museums at Abbeville, Paris, Lyons, etc.

Deutsche Gesellschaft für Anthropologie, Ethnologie, und Urgeschichte, with branches at Berlin, Munich, Göttingen, Stuttgard, Danzig, Freiberg, Hamburg, Mainz, Heidelberg; publishes *Archiv für Anthropologie* and *Correspondenz-Blatt*.
Deutsche Morgenlandische Gesellschaft, Leipsic.
Museums at Berlin, Leipsic, Hamburg, etc.

Gesellschaft für väterländische Alterthumer, Basle.
Museums at Lausanne, Basle, Berne, Zurich, etc.

Revista de Antropologia, organ of the Anthropological Society of Spain.

Direzione dell' Archivio per l'Antropologia e la Etnologia, Florence.

ASIA: Asiatic Society of Bengal.
Deutsche Gesellschaft für Natur- und Völkerkunde Ost-Asiens, Yeddo.
Asiatic Society of Japan, Yokohama.

AFRICA: Musée de Boulay.

Attention is directed to the *American Journal of Science*

and Art, the *American Naturalist*, the *Popular Science Monthly*, and the New York *Tribune* extras; to the London *Academy*, *Athenæum*, and *Nature;* to the *Geographical Magazine;* to *Comptes Rendus*, *Ausland*, and *Gaea;* as helping to keep the world posted upon general knowledge of the subject.

PROGRESS OF PREHISTORIC ETHNOLOGY.

America.—Mr. William H. Dall has collected among the Aleutian Islands, and especially in Southwestern Alaska, from the graves and burial-caves, a large and interesting series of prehistoric objects.

Mr. Henry Gilman will publish in the forthcoming Smithsonian Report a paper on the Mound-builders and Platycnemism in Michigan.

Mr. Paul Schumacher has sent to the National Museum at Washington, from the shell-heaps of the Santa Barbara Islands, some of the most beautiful specimens of soapstone pots and stone mortars which have been collected in this country. Other objects of exquisite workmanship show a high degree of civilization to have existed on these islands. No. 259 of the Smithsonian publications will be a paper on the "Antiquities of Tennessee," by Mr. Joseph Jones. It will appear in the "Contributions to Knowledge."

Great enthusiasm exists among the different states upon the subject of preserving the relics of their early history. At the last Industrial Exhibition in Cincinnati, Ohio, there was a fine display of prehistoric objects. In the Indiana State Fair, Mr. Daniel Hough received a prize for a fine collection of Mound-builders' material. Professor E. T. Cox, state geologist of Indiana, is locating every mound and prehistoric fortified place in the state, and will give in his reports a "complete history of all the relics, so far as they can be had, making a special volume on the subject."

Professor Joseph Leidy figures and describes in Professor Hayden's last report (1872), "Some Remains of Primitive Art in the Bridger Basin of Southern Wyoming;" and in the same volume Dr. C. Thomas gives an illustrated account of some ancient mounds in Dakota.

Professor William M. Gabb continues his researches in Costa Rica, and has brought to light from the graves, etc., of the Talamanca District a large quantity of pottery, stone

implements, etc. Dr. Berendt also publishes in *Nature* and the *Academy* accounts of his researches in Nicaragua.

Mr. Thomas Hutchinson publishes his "Two Years in Peru, with Explorations of its Antiquities." London, 2 vols., 8vo.

Dr. Conto Magalhaes has published at Rio Janeiro a work in Portuguese upon the Anthropology of Brazil. He concludes that man has existed in Brazil 100,000 years; that some of the native languages (the Quichua, for instance) have borrowed about 2000 roots from the Sanskrit. He makes the tall, dark tribes, like the Guaicurú of Matto Grosso, to be the primitive stock, and derives the other shorter and lighter races from a mixture of these with white races in prehistoric times.

The Seventh Annual Report of the Trustees of the Peabody Museum of American Archæology and Ethnology gives an account of the valuable series of objects connected with the South American Pacific Archæology which Professor Agassiz acquired during his voyage in the *Hassler* in 1871–72.

The *Revue d'Anthropologie*, Vol. III., No. 1, 1874, has an account of the discovery of some prehistoric burying-grounds and ancient Indian habitations in Patagonia, by M. G. de Rialle. Colonel Lane Fox read before the Anthropological Institute, November 10, a paper upon a series of flint and chert implements from Patagonia.

Europe.—Professor Worsaae is the author of a treatise in which he derives the earliest culture in the North of Europe from Asia and North Africa, and maintains that the "movement of civilization, since the beginning of the Stone Age, has taken the same northeasterly direction.

Grewingk publishes in *Archiv für Anthropologie* an article "Zur Archæologie des Balticum und Russlands."

To Mr. J. Sawisza belongs the merit of having explored two caves situated in the valley of Wierszchow, near Cracow, Austrian Poland. One of them, called "Mammoth Cave," yielded remains of the mammoth, cave bear, brown bear, elk, stag, reindeer, roe, horse, bison, wild boar, wolf, fox, etc. Nuclei and primitive implements of flint and pierced teeth of animals abounded, but there was no trace of pottery. Another cave in the neighborhood seems to have been the abode of man at a later period, as indicated by the later ani-

mal remains, and by the presence of pottery and polished implements.

Lieutenant Ziegler has discovered near the shore of the Trondhjem Fiord a kjökkenmödding, which has since been examined by Mr. Rygh. It yielded shells of species of *Ostrea*, *Cardium*, *Mytilus*, *Littorina*, *Patella*, *Tritonium*, *Modiola*, *Cyprina*, and *Purpura* — all of which still exist on the coast of Norway. The bones discovered were so much decayed that most of them baffled examination. There were recognized a human frontal bone, a beaver's tooth, and bones of the dog, the elk, and the reindeer. All marrow-bones were broken. The implements discovered were an axe, of reindeer or elk bone, and a lance, several arrow-heads, a cutting tool, and a wedge, all of slate—a material not used by the people who left the shell-heaps on the Danish coast.

An account of researches in Brixham Cave will be found in the journal of the Victoria Institute, February 16, 1874.

The committee for the exploration of the Victoria Cave, Settle, Yorkshire, have discovered among the bones of extinct mammals, under conditions which argue their existence before the Glacial Age, one concerning which Mr. Busk says: "The bone is, I have no doubt, human; a portion of an unusually clumsy fibula, in that respect not unlike the same bone in the Mentone skeleton." See a paper read before Section C of the British Association at Belfast.

Mr. Pengelly read before the same section the tenth report of the committee for exploring Kent Cavern, Torquay.

All anthropologists hear with profound regret of the defeat in the British Parliament of Sir J. Lubbock's bill for the protection of ancient monuments. An abstract of this bill will be found in the last number of the *Annual Record*.

The German Society of Anthropology, etc., is industriously collecting material for a prehistoric map of Germany, which it has resolved to publish. Among the points to be noted on this map will be the position of the most notable prehistoric settlements, fortifications, lake-dwellings, cave structures, burial-mounds, and other places of sepulture. By a judicious use of colors, the various periods — stone, bronze, iron, etc.—will be indicated, and altogether the map will be one of great value to the student of ethnology.

MM. Louis Lartet and Chaplain Duprac explored in Jan-

uary, 1874, a remarkable grotto at the foot of the Pyrenees, near Lorde, on the River Oloron, a tributary of the Adour. This cave seems to have contained deposits belonging to at least two different periods. At or near the bottom lay a crushed human skull, and bones of the skeleton associated with barbed arrow-heads and utensils of bone, and about fifty perforated teeth of the bear and lion, many of them bearing engraved or ornamental lines, representations of barbed arrows, fishes, and other delineations. One of the feline teeth measures four and a quarter inches in length. These perforated teeth represent the ornaments or trophies of the individual whose remains were found at this place. The ancient bear-hunter may have perished accidentally by fragments falling from the roof of the grotto, the crushed skull lying beneath large pieces of limestone. The ground below which these remains were found bore unmistakable evidence of the presence of rude hunters who used to resort to this grotto, leaving there chipped flints and broken bones of the ox, stag, horse, and reindeer. Ultimately, the half-filled grotto served as a burial-place; for in the yellowish-brown earth constituting the upper deposit MM. Lartet and Duprac found thirty-two human skulls resembling the so-called Cro-Magnon type, and many other bones, together with products of primitive art, among them some beautifully chipped implements of flint. The account of the exploration fills two numbers of the well-known "Matériaux pour l'Histoire Primitive et Naturelle de l'Homme."

Allusion was made last year to two human skeletons discovered, together with animal remains and articles of flint and bone, by M. Rivière, in the caves of Mentone, near Nice, France. In the mean time the same explorer has succeeded in finding in caves of the neighborhood three additional skeletons, two of them belonging to children, the other to an adult individual. The head of the latter was surrounded with pierced shells and teeth of the stag, originally forming, doubtless, an ornamental head-dress. There were also discovered remains of a necklace, and of bracelets made of shells and teeth. Curiously enough, this skeleton was stained with oxide of iron, like those previously discovered by M. Revière, who thinks that the covering of the corpse with micaceous specular iron formed one of the funeral customs observed by

the people who deposited their dead in the caves. With the skeleton were found a tooth of the cave bear (*Ursus spelæus*), bones of ruminants, pachyderms, and rodents, and a number of shells of edible marine mollusks; also implements of bone and stone, the latter merely chipped, and mostly consisting of sandstone, limestone, and other materials, but rarely of flint, as in the case of the other discoveries. No implements or ornaments were found with the children.

Parts XIV. and XV. of the "Reliquiæ Aquitanicæ" have appeared during the year, and also Part III. of the first volume of the "Archives du Muséum d'Histoire Naturelle de Lyon." The first part (Livraison) contained "Études sur la Station Préhistorique de Solutré, Saone-et-Loire, par M. l'Abbé Ducrost et M. le docteur L. Lortet." The second part contains, I. "Note sur les Brèches osseuses des Environs de Bastia (Corse), par M. Arnould Locard;" II. "Étude sur le *Lagomys Corsicanus*, par M. le docteur Lortet; III. "Études Paléontologiques dans le Bassin du Rhone, periode Quarternaire, par M. le docteur Lortet and M. E. Chautre." The third part contains a continuation of the last article of the second part.

In the early part of the year two caves in the neighborhood of Schaffhausen, Switzerland, which had long been known and often visited by the curious, though never with a view to investigate their contents, were explored by two gentlemen, MM. Merk and Joos, with results far surpassing their expectations. In digging into the floors of the caves, they found in abundance the broken bones and the teeth of animals characteristic of a former fauna, such as the aurochs (bison), reindeer, elk, bear, wild horse, Alpine hare, arctic fox, and other species of fox no longer existing in Switzerland. The mammoth and rhinoceros were represented by plates of teeth. Bones of birds occurred in great numbers, among them those of the wild duck and white grouse. Traces of domestic animals were, on the other hand, entirely wanting. One of the caves, situated near Thayngen, proved particularly rich in articles of reindeer-horn—needles, piercers, and arrow-heads, which are said to be worked with great precision. Flint flakes used in making them abounded. But the most interesting object found at this place is a delineation traced on a broad piece of reindeer-horn, representing a

reindeer in the act of browsing, and reproduced in the accompanying figure. This sketch is so well executed that it may be considered as the most perfect specimen of art transmitted to us from those remote times. It is certainly superior to the best productions of this kind from the caves of Southern France.

A subject of growing archæological interest is the origin and relationship of the Etruscans, and the attempts to decipher their language are multiplying. The effort of Mr. Isaac Taylor to assign to them a Turanian origin has awakened a great deal of controversy. Dr. Corssen, the first volume of whose great work, containing 1016 pages, has just been published, assigns to them an Aryan origin, in which opinion, of course, Professor Max Müller agrees.

The most scholarly and recent work on prehistoric remains in Europe is "Cave Hunting: Researches on the Evidence of Caves respecting the Early Inhabitants of Europe, London, 1874," by Mr. W. Boyd Dawkins. The author, after narrating briefly the historic interest which has always hung around caves, describes in detail the researches which have been made in all of the principal caves of Europe, and the results which have accrued. Up to its publication, the remains of the Paleolithic man have been discovered in the following caves:

Victoria Cave	Settle, Yorkshire	England.
King Arthur's Cave	Monmouthshire	"
Wookey Hole	Somersetshire	"
Brixham Cave	Devonshire	"
Kent's Hole	"	"
Plass-Newydd		Wales.
Long Hole		"
Hyle's Cave		"
Gailenreuth	near Muggendorf	Franconia.
Moustier	Périgord	France.
La Madelaine	"	"
Laugerie Haute	"	"
Laugerie Basse	"	"
Gorge d'Enfer	"	"
Cro-Magnon	"	"
Les Eyzies	"	"
La Mentone	"	"

Belgian caves of Englis, Chauvaux, Engihoul, Neanderthal (?), Trou de Tronta.

Asia.—Reference was made last year to Dr. Schliemann's interesting discoveries in the plain of Troy. He found there implements of stone in layers covering those that contained articles of copper, bronze, and gold, together with pottery of good workmanship. These facts, so totally at variance with the general results of archæological investigations, have elicited much comment. A comparatively civilized tribe may have been supplanted by a rude tribe unacquainted with metals. He has published "Trojan Antiquities; Report on the Excavations in Troy, with an Atlas containing 218 Photographic Plates explaining the Text. Leipsic, Brockhaus."

In the *Athenæum*, May 9, 1874, is an account of Mr. J. P. Wood's excavations of the Temple of Ephesus.

It is well known that General Di Cesnola, whose wonderful discoveries in Cyprus excited so much attention, and whose collections are now the property of the Metropolitan Museum of Art in New York, signified his intention, after depositing his earlier gatherings, of returning to his field of labor, and of continuing his investigations on a larger scale with the funds thus acquired. This promise he has carried out, and the discoveries now making bid fair to nearly, if not entirely, equal in interest those of his former explorations. He has already found some localities where the works of man in his earliest and most primitive condition have been detected,

forming a very great contrast with those of the later Phœnician, Greek, and Roman occupants of the island. "The language of the Cyprians may be considered as solved." Twenty years ago the Duc de Luynes published his work on Cypriote inscriptions; many scholars went to work on them with varying success. Ten years ago, Mr. Lang, English Consul at Cyprus, found a bilingual dedicatory inscription in Cypriote and Phœnician. Dr. Birch discovered that the language was Greek. Mr. Lang and Mr. George Smith endeavored to decipher them, the latter discovering thirty-three out of the fifty-two characters. Drawn away by his great Assyrian discoveries, his work was taken up by Dr. Brandis, who succeeded in completely unraveling the mystery. The dialect is unique, but resembles in many respects the Arcadian and the Cretan. The alphabet, originally intended to distinguish every primitive syllable by a letter, came in time to represent only the consonants in the syllables. The origin of this alphabet and system of writing remain a mystery, awaiting further research. Recently another bilingual tablet has been discovered.

The Palestine Exploration Fund continues its thorough investigations into the archæology of Palestine and Syria, and though languishing somewhat through want of money, it will no doubt complete the work so nobly begun. The American Palestine Exploration Society, which, by agreement with the English Society, has been operating on the east side of the Jordan, has consummated its arrangements for sending out a large party under the command of Colonel C. Lane in December. Professor Selah B. Merrill is added to the archæological department. Professor Payne, who has been in the field for two years, is preparing the "Third Statement," which will contain, among other matter, an account of his discovery of the sites of Pisgah and Nebo.

Much warm discussion has arisen over the Shapira collection of Moabite pottery, etc., but, through the strenuous efforts of Mr. Clermont Ganneau, it seems to be proved that the objects are forgeries. Messrs. C. Tyrwhitt Drake and A. W. Franks have published a work on the skulls and implements of Palestine.

Mr. George Smith, whose interesting and brilliant career as a cuneiform decipherer has so long interested students of

antiquity, has returned from his second expedition to Mesopotamia. He read before the Society of Biblical Archæology on the 7th of July an account of his last researches in the mounds of Kouyunjik.

Mr. Francois Lenormant has published "Les Premières Civilizations," based on his own and other researches among the monuments as deciphered by the latest investigators.

The Society of Biblical Archæology has published three volumes of ancient texts.

During the year Mr. Schlagintweit Sakulunski has made investigations bearing on prehistoric commerce. It has long been known that jade and some other minerals of which the axes, chisels, scrapers, etc., of the lake and cave periods were made do not exist in sufficient quantity and purity in Europe to justify the opinion that these implements were manufactured by the men who used them, and with whose bones they lie buried. M. Schlagintweit has discovered in the Caucasus and in Northern Armenia, near the great highways of trade from the earliest times, abundant deposits of jade, etc., a fact which goes to confirm the opinion that in prehistoric time caravan or other commerce existed between Western Europe and Asia.

The archæological survey of India, under General Cunningham and his corps of able assistants, progresses rapidly. Mr. Grant Duff, alluding to the work, quotes the general's division of the Remains as follows:

Hindoo Style.

1. Archaic, from B.C. 1000–250.
2. Indo-Grecian, from B.C. 250–57.
3. Indo-Scythian, from B.C. 57–A.D. 319.
4. Indo-Sassanian, from A.D. 319–700.
5. Mediæval Brahmanic, from A.D. 700–1200.
6. Modern Brahmanic, from A.D. 1200–1750.

Mohammedan Style.

1. Ghori-Pathan, with overlapping arches, A.D. 1191–1289
2. Khilji-Pathan, with horseshoe arches, A.D. 1289–1321.
3. Tughlak-Pathan, with sloping walls, A.D. 1321–1450.
4. Afghan, with perpendicular walls, A.D. 1450–1555.
5. Bengali-Pathan, A.D. 1200–1500.

6. Jaunpori-Pathan, A.D. 1400–1500.
7. Early Mughal, A.D. 1556–1628.
8. Late Mughal, A.D. 1628–1750.

Some very interesting polished stone implements from Japan testify to the existence of a stone age at some period in the history of that country.

Africa.—The establishment by the Khedive of a Museum at Boulaq, near Cairo, in Egypt, and the successful labors of M. Marriette Bey in collecting new and in arranging old materials, have been the means of awakening a new interest, and of facilitating greatly the labors in the study of Egyptology. The works following up his collections are legion. Among them we notice a "Memoir on the Comparative Grammar of Egyptian, Coptic, and Ude," by Hyde Clarke, Trübner & Co., 1874; a paper "On the Discovery of Stone Implements in Egypt," by Sir John Lubbock, Bart., in the journal of the Anthropological Institute, June 9, 1874; and another in the same number, by Professor Richard Owen, "On the Ethnology of Egypt." F. Chabas, the late distinguished Egyptologist, in his "Études sur l'antiquité historique d'apris les sources Egyptiennes et les monuments réputés préhistoriques," proposes to bring the light of modern researches in Egypt to bear upon the problem of the antiquity of man. Though there is no doubt that the papyri will clear up many difficulties surrounding the origin of the present European nations, the antiquity of the human race in Europe rests rather on geological and paleontological grounds than upon archæology.

Polynesia.—In *Nature* of September 17, 1874, is a notice of a hieroglyphic sculpture and tablet from the Easter Islands, and Mr. Thomas Croft, of Papieti, Tahiti, exhibited before the California Academy of Sciences, November, 1873, photographs of these exceedingly interesting objects.

Professor Owen, in his Inaugural Address before the Ethnological Section of the Congress of Orientalists, says: "Zoological and geological evidence concur to point to a prehistoric race of mankind, existing generation after generation, on a continent which, in course of gradual, non-cataclysmal, geological change, has been broken up into insular patches of land, and there such race is open to ethnological research and

study. The cardinal defect of the speculators on the origin of the human species seems to be the assumption that the present geographical condition of the earth's surface preceded or co-existed with the origin of species." He further advised Orientalists to cast away "prepossessions as to time, place, affinity, race, etc., for which there may not be rightly observed, well-determined data, and to bring to bear on the dark vistas of the past in human history the pure, dry light of science." He also hoped to see the day "when truer terms will be applied in ethnology to groups of peoples and of tongues now called respectively Hammonic, Semitic, and Japetic."

PREHISTORIC NOTES OF GENERAL IMPORT.

The question whether man already existed in tertiary times is a topic now much discussed by French anthropologists. There have been found in tertiary strata flints supposed to bear the marks of human workmanship. Among the principal supporters of this view are MM. G. de Mortillet, Havelacque, and Bourgeois, the latter a Catholic clergyman. Another interesting subject of discussion is the supposed gap or hiatus between the paleolithic and neolithic phases of the stone age, the neolithic period being distinguished from the earlier phase, not only by chipped flint implements of superior workmanship, but also by the process of grinding and polishing in the manufacture of weapons and tools of stone. Some maintain that the later stone implements owe their origin to a new people differing from the savage tribes who were coeval with the extinct animals, and who employed exclusively unground flint tools of rude character; while others question the reality of an interval between the two phases, and ascribe the superiority of the more recent manufactures of stone to the gradually developed mechanical skill of the primitive inhabitants of Europe.

Mr. James Geikie has published this year a work entitled "The Great Ice Age, and its Relation to the Antiquity of Man," in which he advances views differing from those held by many other geologists. He is of opinion that certain animals, whose remains occur commingled in river-gravels and in caves, can not have existed in the same period, and he therefore believes in alternate changes or oscillations

of climate, which permitted tropical and northern species of animals to inhabit certain localities of Europe at different periods, when the temperature was congenial to their respective habits. Tropical quadrupeds, like the hippopotamus, tiger, and hyena, he thinks, can not have lived side by side with the reindeer, musk-ox, mammoth, and woolly rhinoceros, and he rejects the views of those geologists who try to get over this difficulty by assuming that the animals of the first-named class migrated annually at the beginning of the severe season to warmer regions, and returned as soon as milder weather set in. It remains to be seen whether Mr. Geikie's conclusions concerning the glacial epoch will be adopted.

RESEARCHES AMONG LIVING TRIBES.

The progress of historical study must be in two directions, toward a better knowledge of the past, and toward a better knowledge of the present. The latter rests on testimony, the former is comparative and deductive. As in the study of geology we find the forms of living beings in any age to be a compendium of all preceding ages, and as the present epitomizes all the past, so in ethnology we find now living on the earth tribes who are using the weapons, tools, and vessels of the extinct races, so that by the possession of a single arrow-head, knife, or piece of pottery, we may predicate with almost certainty the social condition of the men who used them. Persons collecting material among living tribes can not be too careful in excluding objects, inasmuch as specimens which may seem wholly insignificant of themselves may be valuable beyond price in making up a series.

North America.—Our knowledge of the tribes of Southwestern Alaska and of the Aleutian Isles has been greatly increased during the past year by the researches of Mr. William H. Dall, of the United States Coast Survey, and of Mr. Henry W. Elliott, United States agent for Alaska, and by the interesting and valuable material which they have sent home.

Mr. T. G. B. Floyd, in the journal of the Anthropological Institute (read February 24, 1874), has an interesting paper upon the Bœthucs, a term applied to the so-called Red Indians formerly of Newfoundland.

Mr. A. P. Reed, in the same journal (read March 10, 1874), describes the half-breed races of Northwest Canada.

No. 267 of the Smithsonian Publications contains a paper by Mr. James G. Swan on the Haidah Indians of Queen Charlotte's Island. The memoir is exceedingly interesting, both for the facts contained and for the relations which it traces between these tribes and those living all along the coast farther north. Accompanying the article are seven well-executed lithographic plates, some of them colored, representing the carvings and designs of the Haidah Indians. These designs stand for the family totems, and are tattooed on their bodies. They erect, in front of the houses of their chiefs or principal men, carved posts or pillars fifty or sixty feet high, so elaborately executed as to cost often several thousand dollars, and looking like great obelisks. The entrance to the lodge is through a hole in the post near the ground. The chief, or head man, owns the house, and the occupants are his family and relatives, each of whom will have on some part of the body a representation in tattoo of the particular figure on the post which constitutes his or her family name or connection. The chief will have all the figures of the post tattooed on his body, to show his connection with the whole.

Among the additions to our knowledge of the western Indians made by the United States surveying parties are reports by Lieutenant Colonel Wheeler, on the culture and languages of the Apaches, Navajos, Tehuans, Tontos, Waltoans, Isolettes, and Moquis, and by Major J. W. Powell, on further researches among the Utah Indians in the neighborhood of the Uintah River. The major on a former trip gathered, among a vast amount of precious material, thirty-six chipped stone knives, set in handles. The blades are of chert, chalcedony, jasper, obsidian, etc., oblong triangular, or oblong tongue-shaped, acute, and they so much resemble many of the so-called lance and arrow heads in our collections that we shall have to modify our views as to the use of many of the latter. The handles are about three inches long, some being merely round sticks three quarters of an inch in diameter, and others flat. A notch half an inch deep receives the blade, which is held in place by plenty of pitch melted into the slit and around the joint. The Northern Boundary Survey and Professor Hayden's party have also sent in some valuable objects.

Central America.—Mr. Belt, in his work "The Naturalist in Nicaragua," divides the American aborigines into maize-eating and manioc-eating. The first class embraces Yucas, Aztecs, Toltecs of Central America, Indians of Florida, Cuba, and Hayti. The second class embraces Caribs, Indians of Guiana and Brazil.

Professor Gabb, in addition to his researches into the natural history and archæology of Costa Rica, has found time to gather a fine collection of objects among the Blanco or Talamanca Indians.

South America.—The knowledge of South American tribes is increased by the publications of H. W. Bates, "The Naturalist on the Amazon," by the researches of Professors Hartt and Orton, and by the French expedition to Terra del Fuego (*Nature*, April 9, 1874).

Europe.—The Anthropological Society of Paris has decided on offering a gold medal of the value of 500 francs to the author of the best manuscript on the ethnology of the population of any part of France. The prize will be awarded in 1876, as well as prizes of less value to the manuscripts next in importance. Special attention is to be directed to the origin, anthropological characters, language, and geographical distribution of the races, and to any particular customs.

Asia.—All eyes are now directed to the advance of Russian power into Western Central Asia. In addition to the political importance attaching to this movement, our knowledge of the tribes of men inhabiting a country so long locked up against the explorer will be greatly increased. Numerous accounts from different divisions of the advancing army fill our best journals. The works of M. G. de Rialle and of Mr. McGahan embody the best information on the subject.

The best accounts of researches among the inhabitants of India, China, Japan, etc., will be found in the *Journal of the Royal Asiatic Society*, London; the *Journal Asiatique*, Paris; and the *Zeitschrift der morgenländischen Gesellschaft*, Leipsic.

Africa.—We have in *Bulletin de la Société d'Anthropologie de Paris* (Vol. VIII.) the report of General Faidherbe, under the direction of the commissioners from Algeria, upon the anthropology of the province. M. Topinard divides the history of the country into five periods: that of—1, the brown-skinned Kabyles; 2, light-skinned Kabyles; 3, the Numid-

ians; 4, the Romans, Arabs, and Turks; 5, Aryans. In the same journal General Faidherbe gives an account of the ethnology of the Canaries.

We have elaborate accounts of the Ashantee War and of the tribes in the route of the British Army from Messrs. G. A. Hentz, Frederick Boyle, Winwood Reade, Henry M. Stanley, Henry Brackenbridge, Captain of the Royal Artillery, J. A. Shertchley, and Dr. Rowe, chief of staff to Sir John Glover. Dr. A. Bastian is about to publish a map and illustrations giving the results of the German expedition to the coast of Loango.

The travels of Dr. Georg Schweinfurth in the "Heart of Africa," and over the routes of Petherick and Miss Tinné—although he penetrated much farther than they—introduce us into the country of the Bongo, Dyoors, Dinka, Niam-Niam, and of the Monbuttoo and other tribes. The most interesting of his discoveries were the Akka, a tribe of pigmies or dwarfs, to whom Herodotus alludes, and who have been incidentally mentioned by many old writers, as well as by Krapf and Du Chaillu. He succeeded in bringing one part of the way home with him to Berber, where poor Tikkitikki succumbed to change of air and diet. A translation of Dr. Schweinfurth's admirable work is published by Harper & Brothers.

In *Revue d'Anthropologie* (Vol. III., No. 3), Dr. Berenger Feraud describes the tribes who occupy the shores of the Casamanca River in intertropical Africa.

A paper was read before the Geographical Section of the British Association at Belfast, on the explorations of Dr. Nachtigall in Baghirmi and other adjoining regions of Africa, from 1869 to 1874.

The Geographical Society of Italy, Florence, has received from Alexandria two living individuals of the tribe of Akka, or Pigmies, of Tikku-Tikku, whom Miani had bought of King Munza. These individuals, of whom one is eighteen years old and forty inches high, and the other sixteen and thirty-one inches high, are pot-bellied, thin-limbed, and knock-kneed. The crania are spherical and prognathous; the limbs are very long, and their skins are copper-colored.

Very interesting accounts have reached us from time to time of the expedition of Lieutenant Cameron, in search,

among other things, for the missing journal and papers of Dr. Livingstone.

Madagascar and its people are described by James Sidbree in an octavo volume, published in London.

A review of "Die Eingebornen Süd-Afrika's, ethnographisch und anatomisch beschrieben," occurs in *Nature*, April 23, 1874.

Dr. Bleek has made to the House of Assembly of Cape Colony his report on "Researches into the Bushman Language." He has had the advantage for two years and a half of the constant presence of two Bushmen, from whom he has taken down more than four thousand columns of text, besides genealogical tables, animal and stellar myths, etc.

Australia.—The Mixed Races of Australia are the subject of an interesting paper by the Rev. George Taplin, before the Anthropological Institute, March 10, 1874.

In *Nature*, October 29, 1874, is an account of a letter from William Ridley, of Paddington, Sydney, Australia, to Sir John Lubbock, in which are some wonderful confirmations of statements made in the "Origin of Civilization," drawn from the aboriginal Murri race.

New Guinea.—The travels of Dr. A. B. Meyer, and of Luigi Maria d'Albertis, in New Guinea, are noticed in *Nature*, December 4, 1873, and those of Dr. Von Miklucho Maclay in *Nature*, February 26, 1874. The announcement is made in *Academy*, October 24, 1874, that the latter has made preparations for undertaking another expedition to New Guinea, in order to devote himself to the ethnological and linguistic peculiarities of the various tribes. He will also carry on a systematic series of geological and meteorological observations.

In *Aus der Natur*, November 21, 1874, will be found an account entitled "Die Samoagruppe, ihre Bewohner und Erzeugnisse."

ZOOLOGY.

On comparative physiology, from the side of zoology, a series of lectures, by M. Claude Bernard, have appeared in *La Revue Scientifique*. One of the numbers contains a review of what is known on the impregnation of the egg, and the law of production of the sexes. He thinks that the problem

of the production of sexes at will is one the solution of which will "remain for a long time in a condition of illusory hope." Professor E. van Beneden, of Liège, considers that the process of fecundation in animals consists in the union of an egg with a certain number of spermatozoids, this act having no other end than bringing together chemical elements of opposite polarity, which, after having united for a moment in the egg, separate again; for in most animals, as soon as the division of the yolk into two portions appears, the elements out of which the outer layer is formed are already separated from those which constitute the internal layer of the embryo. The new individual is formed at the moment when the union between the elements of opposed polarity is effected, as absolutely as the molecule of water is formed by the union of atoms of hydrogen and oxygen. Van Beneden maintains, from the facts afforded by other embryologists, that the same sexual differences occur in the two embryonal layers of the vertebrates as in the polyps, and he thinks it probable they will be found to exist in all animals. This bears out the prevalent idea that the sex of animals is determined at the time of impregnation.

M. Dareste gives in the *Archives of Experimental Zoology* a memoir on the origin and mode of formation of double monsters.

An interesting paper on the sound produced by European fishes, by M. Dufosse, appears in the *Annales des Sciences Naturelles*, while M. Baudelot prints in the *Archives de Zoologie Expérimentale* a paper on the scales of the bony fishes.

Some interesting remarks on hybridism among ducks have been made by Dr. Brewer. For a large proportion of remarkable cases, where the evidences of the parentage on both sides are well marked, the common mallard duck figures as one of the parents. The specimens described by Audubon as *Anas Breweri*, the like of which has never since been obtained, is presumed to have been a cross between the wild mallard and the gadwall or gray duck. A cross between a male canvas-back and a female tame mallard existed for several generations, preserving with a remarkable degree of uniformity the markings of their origin. The so-called Cayuga Lake duck had the characteristic peculiarities of the male mallard and the female Muscovy. The race of

hybrids between the canvas-back and the mallard was nearly twice the size of either parent; and this is equally true of the Cayuga hybrid.

It is often claimed that if the care of man be withdrawn, an improved breed will retrace the steps of its ancestry. and revert to its original characteristics. For some years Professor Brewer has been investigating this subject, and seeking for proof of the alleged tendency to reversion. To carefully worded inquiries in writing, following upon every report of such "reversion," Professor Brewer has received very numerous replies, and they are unanimous in the negative. This is certainly remarkable, following upon the confident assertions that animals so frequently exhibited the alleged tendency. The inquiries were pushed in the specific localities where the reversion was said to have occurred; the questions have been put to a large number of stock-breeders, and finally have been made by means of a printed circular. But the result was always the same, except that a smile of incredulity extended over the faces of some stock-breeders when such inquiries were put to them, and they feared they were to be made the victims of a "sell." No instances of the alleged "reversion" having been authenticated in Professor Brewer's experience, he asked the association to aid in exposing and refuting the pernicious notion.

Besides the ordinary normal mode of reproduction, several genera of the phyllopod crustacea are known to reproduce by what is termed by Professor Owen *parthenogenesis*, or virgin reproduction; *i. e.*, the eggs arise from the ovary by a budding process, like the budding of leaves on a tree, through the simple multiplication of cells, without fertilization by the male spermatic cell. This occurs in several insects, as in the *Aphis*, the honey-bee, the silk-moth, etc., and in *Daphnia*, the water-flea, and in other *Entomostraca*.

A Russian naturalist, Schmankiewitsch, in 1872 discovered a variety of "*Branchipus*" (*Artemia*) *arietinus* near Odessa. In the summer and autumn of the year before he noticed that this *Artemia* changed its form, corresponding to the greater or less saltness of the water. In summer, when the water was most salt, there was a retardation in growth; and this retardation was the more evident the higher the temperature and the more concentrated the solution of salt.

Toward the end of the summer, when heavy rains set in, and the temperature decreases, the *Artemia* becomes larger, loses its red and gray color, and becomes clear and transparent, so that the July generation has important differences from that which appears in November. In order to observe this phenomenon carefully, he undertook the artificial breeding of the *Artemia* in two different ways. In one vessel he increased the saltness of the water up to 18° Baumé, in another he reduced the solution to 3°, and thus reared several generations. In both cases, he remarked that each new generation easily lived in such a concentrated solution as the previous generation could scarcely live in. By raising them in so different solutions (18° and 3° Baumé), very different forms of *Artemia* were obtained, which were not to be found in their original pond.

"While carrying on these observations, he at the same time proved that a parthenogenetic reproduction exists in *Artemia*. Each time, both in the great increase of the weak solution as well as in the greatly increased saltness of the water, the females produced new generations, despite the absence of the males. Under these relations of the solutions, in warm weather only females were produced. These females produced in similar breeding-jars only female offspring. Only in water of medium strength were produced males."

As a further illustration of the influence of physico-chemical surroundings on the organization of these animals, I will again quote from the abstract of the remarks of our author: "In the salt-pools in the neighborhood of Limans (near Odessa), he found in the spring, together with *Branchipus* (*Artemia*) *ferox*, Gr., a very peculiar *Artemia*, which he thought was undescribed. He thought from certain characters that this species belonged to the higher group of *Branchipus*. In this form he observed some strange differences in the structure of the sexual organs, changes which could scarcely be regarded as pathological. Usually, the horns (lower antennæ) of the females are small, but in the old females they are clearly elongated, and are very much like the claspers of the males. Still earlier appears a striking change in the structure of the genital organs, wherein some characteristics of the male organs appear. In like manner, the sexual organs are

clearly changed in the old males; and in the sacs in which the outer sexual organs lie we find a space which is very similar to the ovisac of the *Branchipus ferox* Gr. In such old males the spermatic particles are very clearly enlarged. How far these changes could go on he could not say, since this *Branchipus* is short-lived. These changes in the sexual organs are especially marked in old individuals; and he further remarks that such misshapen forms often occurred in the salt-pools after heavy rains" (Siebold & Kölliker's *Zeitschrift*, 1872, p. 293).

Such facts as these show how desirable collections in very large numbers, at different seasons of the year and from different localities, are for the proper study of these animals. Moreover, they are among the most important facts showing how new generic and specific forms, as well as a sexual reproduction, arise in consequence of changes in the physical surroundings of animals.

One of the most important contributions of the year to the theory of evolution are the results of Professor Hyatt's studies on the Ammonites. He finds every where throughout the group two methods of development—one by a slow accumulation of differences, according to the Darwinian theory; the other by their quick or sudden production, according to the law of acceleration, as explained by Cope and himself.

Pouchet has shown that in fishes which are known to change their color by living on different bottoms, light and sandy, or dark and muddy, the change is produced through the nervous system. In fishes whose eyes were put out such changes were not brought about. It seems evident, then, that the change of color is caused by the action of light on the retina of the eye. From this fact of a change in color by the presence or absence of the eyes, Dr. Packard has suggested that in the blind fish of the Mammoth Cave we can account for the absence of color in the skin, and its white appearance. Having no eyes, no stimulus is conveyed to the pigment cells of the skin; they are aborted, and consequently the skin turns white. The other blind crustacea and insects are probably rendered white from the same cause.

In the geographical distribution of animals, it has been found that the *Lepidoptera* of North America probably follow, as regards size, a law the reverse of that established by

Professor Baird for the birds and mammals, who had shown that they decrease in size southward. In insects the size increases southward. Professor Baird's law of increase in length of the peripheral parts westward, extended by Allen, also obtains in the *Lepidoptera*. In the family of *Phalænidæ*, or geometrid moths, Dr. Packard finds that the Western, *i. e.*, the Coloradian and Pacific coast individuals have a greater expanse of wing, and often more pointed ones, than in the same species from the New England States. He also finds that the variations from the Eastern type occurs in the same species found in the Alps. A curious analogy is shown to exist between the moths of the Colorado plateau and the elevated region around the Ural and Atlas mountains, and the plateau of Asia Minor; certain generic types occurring in those regions not found elsewhere. These resemblances are attributed to similar climates, tne amount of rain-fall in Colorado and adjacent regions being like that of Western China and Amoor land; while the rain-fall of the region about the mouth of the Columbia River is nearly the same as that of the southern side of the Alps. Some species of moths have brighter and deeper colors westward than their eastern representatives. He thinks that differences in climate are most important factors in producing varieties and species.

In this connection should be noticed the facts brought out by Mr. J. A. Allen in regard to the varieties of American squirrels. It seems from his studies, based on very extensive material, that Southern squirrels are more highly colored than Northern ones; Western specimens, from the dry plains, are paler, more faded out, than Eastern ones; Southern specimens are also smaller than the Northern darker forms. Consequently he divides the continent into five more or less well-marked areas, characterized by certain peculiarities of color variation in birds and mammals. N. J. Elwes has also published an interesting essay on the distribution of Asiatic birds, illustrated by an excellent map.

The *Challenger* has resumed her voyage through the antarctic seas, her naturalists aboard sending home accounts of the novelties discovered by means of the dredge and trawl. They have found a considerable number of species common to the two poles, and greatly extended our knowledge of the deep-sea fauna, which at great depths seems remarkably

uniform over the globe, the temperature of the ocean bottom being very uniform. The trawl was used in 1600 fathoms, bringing up the well-known deep-sea genera *Euplectella*, *Hyalonema*, *Umbellularia*, and the coral *Flabellum*, together with two new genera of Crinoids, some new *Echinoderms*, and remarkable crustacea. The deepest trawling was done in 2600 fathoms, when holothurians were taken in abundance, with several star-fishes, actiniæ, and an elegant brachiopod shell.

The labors of the United States Fish Commission were prosecuted at its head-quarters at Noank, Connecticut, and dredging was carried on within a radius of twenty miles. One of the most interesting facts brought out by Professor Verrill and others was the discovery that the cold Northern current which passes around Cape Cod to the south of Martha's Vineyard, and is cut off from Vineyard Sound and Buzzard's Bay by the main belt of shore water, strikes into Fisher's Sound, bringing with it the characteristic Northern animals; so that, quite contrary to the usual expectation, the general fauna of the vicinity of Noank and Watch Hill is more boreal than that of Newport and Wood's Hole. Researches in the deeper parts of the Gulf of Maine were carried on by Messrs. Packard, Cooke, and Rathbun, in the United States Coast Survey steamer *A. D. Bache*, afforded the Fish Commission by the Superintendent of the Coast Survey. The general results confirm those of the previous year, while a number of forms new to the coast of New England were discovered. The dredgings carried on by Mr. Dall about the Aleutian Islands have brought out interesting results.

Extending, now, our summary to the results of the year from work done by zoologists in special classes, we find that much attention has been paid to the *Protozoa*, research in this direction having been stimulated by the works of Haeckel, Cienkowski, Carter, the late H. J. Clark, Lankester, Balbiani, Stein, and others, in years past. As tending to prove that the *Bathybius* is really a living being, we may cite the discovery by Dr. E. Bessels, of the *Polaris* expedition, of a new *Moner*, belonging to the lowest division of protozoa. It has been named *Protobathybius Robesonii*.

Letters from the *Challenger* party state that one of the naturalists aboard has paid great attention to the ooze, with the object of discovering the *Bathybius*. He finds that the

Globigerina mud is full of the pseudopodia of that foraminifer, worked up more or less into a general slime. When alcohol is added to this, the pseudopodial matter is precipitated, and this is the precipitate figured by Haeckel as *Bathybius*. If large living specimens of the foraminifera are separated by the sieve from the mud, and then placed in alcohol, a similar precipitate is obtained. It would seem from this as if *Bathybius* might simply be a dead mass of protoplasm resulting from the decay of these foraminiferous organisms; but Bessels has, on the other hand, seen well-marked amœboid movements in *Protobathybius*, indicating that *Bathybius* is a living organism.

Dr. Greef, in further studies on the fresh-water *Pelomyxa* (previously called *Pelobius*), finds that it reproduces by throwing out amœba-like masses which grow into zoospores. In all respects it is a higher organism than the *Bathybius*, or even the *Amœba*, which simply reproduces by self-division of the entire body-mass.

A fierce controversy has been raging about the animal nature of Eozoon, the supposed giant foraminiferous creature of the Azoic or Laurentian period. Messrs. King and Ronney on the one side, and Dr. Carpenter, have renewed the controversy of past years; while the number of skeptics as to its organic nature seems increasing on both sides of the Atlantic.

Much attention has been paid to the fresh-water *Amœba*, and other Rhizopods of this country, by Professor Leidy. He has brought to notice several most interesting forms allied to *Amœba* and *Difflugia*. Among them is a singular form, the *Amœba sabulosa*, which swallows an amount of quartzose sand equal to more than half its bulk.

Another curious form of terrestrial Rhizopods was found in rainy weather in the earth about the roots of mosses growing in the crevices of the bricks of the pavements in Philadelphia. The animal, with its outstretched threads of protoplasm (*pseudopodia*), has been compared by Professor Leidy to a spider stationed at the centre of its well-spread net. "Imagine," he says, "every thread of this net to be a living extension of the animal, elongating, branching, and becoming confluent so as to form a most intricate net; and imagine every thread to exhibit actively moving currents of a viscid

liquid both outward and inward, carrying along particles of food and dirt, and you have some idea of the general character of a *Gromia*." Another form is allied to the curious Pelomyxa described by Greef. The entire body, and even the protoplasmic outstretched threads, bristle with innumerable silicious spicules. This wonderful organism is called *Deinamœba mirabilis*. The wonder exists in the fact that such evidences of active will-force, or energy, of such complicated physiological processes as digestion and reproduction, can go on in a simple mass of partly transparent jelly-like protoplasm, the animal representing a single cell, without organs, unless it possess a nucleus, which Leidy was unable to discover. The wonderful properties of the substance we call protoplasm are further shown in the studies of Dr. Bütschli, of Kiel, on the organization and reproduction of the Infusoria. Though the Infusoria proper are much more highly developed than many naturalists suppose, Bütschli denies that they produce spermatozoids which fertilize the nucleus (ovary), as asserted by Balbiani and Stein. He also believes that lasso-cells, like those in Hydra and jelly-fish, are developed in a certain infusorian (*Polykrikos*), though he believes that the Infusoria represent a single cell. This latter point Haeckel has endeavored to prove in an elaborate paper, containing also a revision of the classification of the Protozoa. However, it seems to make little difference whether these strange Protozoa are many-celled or unicellular, as the processes of life exhibited by them are due to the protoplasm. As observed in last year's *Record*, histologists now recognize the fact, to use the words of another, "that the phenomena of life, whether exhibited in the building up of structure or in the transformation of energy, are solely dependent on the life-stuff—protoplasm—and that the corpuscular or cellular condition of that life-stuff is a secondary accident." Several new Infusoria have been described by Haeckel and others; while the remains of several Rhizopods have been found in the hot springs of the Azores. Ascending to the Rotifers, Professor Leidy has experimented on the common Rotifer found in the dirt adhering to the mosses in the crevices of pavements in Philadelphia, in order to determine how far they could be revivified after drying up. It appears that the Rotifers and their associates become inactive in compar-

atively dry positions, and may be revived on supplying them with more moisture; but when the animals are actually dried, they are incapable of being revivified. "Moisture," he adds, "adheres tenaciously to earth, and Rotifers may rest in the earth, like the Lepidosiren, until returning waters restore them to activity."

Dr. Salensky, of Kasan, Russia, has a paper, with several plates, entitled "The Development of the Rotifer, *Brachionus urceolaris*," in Siebold & Kölliker's *Zeitschrift*.

An elaborate paper on the development of certain English silicious sponges, by Mr. Carter, appears in the *Annals and Magazine of Natural History*. It seems that the embryos are cast off in July and August, as we have found to be the case in similar sponges at Penikese during the past summer. Many fine forms have been obtained by the United States Fish Commission at Noank and in the Gulf of Maine. Large collections have been made in Florida by Dr. Palmer, and, with those dredged by Count Pourtalès, we have in American museums tolerable material for a work on our native forms. A remarkable sponge from the Gulf of Maine has been described by Professor Verrill under the name of *Dorvillia echinata*. It is four inches in diameter, and supported on a broad, stout, but short peduncle, forming one half of the total height. Other species discovered at great depths in the North Atlantic by the British exploring expeditions have been found in seventy to one hundred fathoms off the coast of Maine. Mr. Carter has also published descriptions of deep-sea sponges dredged by the English *Porcupine* expedition. Mr. Bowerbank's volume on Sponges has been published by the Ray Society.

The Radiates still receive attention from Mr. Alexander Agassiz, who has completed his monograph of the Echini. It occupies between seven and eight hundred pages, with about fifty plates, and will long continue to form the standard work on the order.

Count Pourtalès has described some remarkable Crinoids dredged by the late Professor Agassiz on the "Hassler."

The development of certain jelly-fishes (*Ctenophoræ*), belonging to the genera *Idyia* and *Plersobrachia*, has been elaborated with great care and beauty of illustration by Mr. A. Agassiz. He gives a connected account of their history,

from the earliest stages in the egg until all the features of the adult appear. While the mode of segmentation of the yolk is extraordinary, the embryo attains the adult form without any metamorphosis, the changes being very gradual. Mr. Agassiz's observations, with the preceding ones of Müller, Gegenbaur, Kowalevsky, and Fol, give us a tolerably complete view of the mode of development of this order of jelly-fishes. Those *Ctenophoræ* on our coast spawn late in the summer and fall. The young brood developed in the autumn comes to the surface again the following spring, nearly full-grown, to lay their eggs late in the summer. The autumn brood most probably passes the whole winter in deep water, and it must take from six to eight months for the young to attain their maturity. The memoir closes with a vigorous and trenchant criticism of Haeckel's "Gastrula" theory, exposing its weak points. He regards the assumptions of Haeckel forming the basis of his Gastræa theory as "wholly unsupported." It must "take its place by the side of other physio-philosophical systems;" and he denies that we have been "able to trace a mechanical cause for the genetic connection of the various branches of the animal kingdom."

Professor P. Martin Duncan, in a series of papers on the nervous system of the sea-anemone, substantiates the discovery made by Schneider and Rötteken of isolated nerve cells near the pigment cells at the base of the tentacles of the *Actinia*, supposed to be eyes. In connection with these nerves are certain round refractive cells (Haimean bodies), and other long cells, called the Rötteken bodies. The former, he thinks, carry light more deeply into the tissues than the ordinary epithelial cells. This is also the case with the elongated Rötteken cells, and others similar to them, called bacilli. All these, he believes, with Schneider and Rötteken, when in combination, concentrate light. "When they are brought together in this primitive form of eye they concentrate and convey light with greater power, so as to enable it to act more generally on the nervous system, probably not to enable the distinction of objects, but to cause the light to stimulate a rudimentary nervous system to act in a reflex manner on the muscular system, which is highly developed.

A new order of Hydrozoa, called *Thecomedusæ*, has been

discovered by Professor Allman, who has recently published a brief account of them. The animal, which was discovered in the south of France, is attached to a sponge, and permeates the spongy tissue. Although a hydrozoan, it is not a hydroid, and can not be referred to any of the existing orders of the hydrozoa. The chitinous tubes which permeate the sponge-tissue are united toward the base of the sponge, and constitute a composite colony of zooids. In many respects this new hydrozoan resembles the Campanularian zoophytes. The name of *Stephanocyphus mirabilis* has been given by the Professor to this beautiful object. In no instance was this zoophyte unaccompanied by the sponge.

Professor Allman has been studying the development of a hydroid, *Myriothrela;* while Kleinenberg, in an elaborate discussion of the anatomy and development of the common Hydra of fresh waters, makes it evident that this animal passes through no proper larval stage; but passes from the condition in which it first becomes free to its adult state by continuous growth without any true metamorphosis. It seems that this animal, viz., *Hydra viridis*, contains grains of chlorophyl. Professor Allman, in commenting on the work of Kleinenberg, remarks that the germ-layers of the Hydroids are "similar in their origin from the primitive embryo layers to the equivalent tissues of the higher; for the nervo-muscular tissue of the Hydroida has its foundation in the ectoderm, which is equivalent to the united outer and middle germ-lamella, while the digestive surface is plainly formed by the endoderm, or inner germ-lamella. Here, as in the higher animals, the origin of the generative system is still an open question; and it is probable that it is not in every case derived from one and the same lamella, for while Kleinenberg is very certain of having traced it to the ectoderm in Hydra, my own researches are in favor of its endodermal origin in other Hydroida." It will be seen from such studies as these that our leading naturalists are not concerning themselves with mere descriptions of new species and systematic works. Enough of this preliminary work has been accomplished to warrant more difficult and careful researches on the histology, anatomy, and embryology, as well as morphology of animals—matters with which, unfortunately, few naturalists are found in this country able to busy themselves.

The Ophiurans have been further discussed by Mr. Lyman in the *Bulletin* of the Museum of Comparative Zoology.

In the department of Mollusca, we have several papers on their embryology by German observers. In the *Niederlandisches Archiv für Zoologie*, Vol. I., Part I., is a paper by Dr. Emil Selenka, the editor, on the "First Formation of the Embryo in *Tergipes claviger*," illustrated by a plate. In Part II., the same author has a paper on "The Primitive Layers of the Embryo in *Purpura lapillus*," also well illustrated. Both these papers belong to the newer embryology; that is to say, the author occupies himself with the exact following out of the origin and disposition of the cellular elements of the embryo. In his paper on *Purpura*, Dr. Selenka proposes to distinguish two modes of formation of the blastoderm—"epiboly" and "emboly." The former is accompanied by the presence of a large food-yelk, and the egg is consequently meroblastic, or partially so. The first formative cells grow *over* the partially segmented or wholly unsegmented colored yelk. In emboly, the egg is holoblastic, and a pushing in of the cells of the primitive blastosphere takes place.

Dr. Salensky, of Kasan, has a paper, with several plates, on "The Development of the Prosobranchiata," in Siebold & Kölliker's *Zeitschrift*, Part IV., for 1872, which has much interesting matter on the "Veliger" larval form of various genera, but does not deal with the histogenesis.

"The Development of *Gastropoda opisthobranchiata*" is the title of a paper by Dr. Paul Langerhans in the same journal, Part II., for 1873, in which some points in the early development of *Acera bullata*, *Doris*. and *Æolis peregrina*, are shortly treated from the point of view of the germ-layer theory.

Mr. Lankester read a paper before the British Association "On the Genealogical Importance of the External Shell of Mollusca," in which he attempts to show the typical form of the immense variety of shells, and especially to homologize the pen of the cuttle-fishes with the shells of the lower Mollusca.

In descriptive malacology, Mr. Dall presents a paper on the shells of Behring's Strait, and numerous exotic species are described in foreign journals. Mr. Conrad describes two new fossil shells from the Upper Amazon, at Iquitos, one hundred miles west of Pebas. They were collected by Pro-

fessor Orton in his second journey across the Andes and down the Amazon. They belong to fresh-water genera, and help to define the nature of the habitat of the group. They confirm the opinion of Mr. Conrad, previously expressed, that the deposit was a basin of fresh water, to which brackish water had access at times. The *Hemisinus* is a melania-like shell, which occurred crowded in the clay in such perfection that the species must have lived and died on the spot, and as the living shells of the genus inhabit the fresh-water rivers of South America, very far from salt water, they are as much fresh-water as are those of *Melania.* The Pebas clay is crowded with other fresh-water shells of the family of *Melaniidæ.*

Professor Verrill gives an account of the gigantic cuttle-fishes of Newfoundland, illustrating his remarks by some facts heretofore unknown regarding the smaller New England forms. Meanwhile a gigantic cuttle-fish, measuring about fourteen feet long, has been captured in Japan.

Dr. Stieda has published a memoir on the nervous system of the Cephalopods.

The Ammonites have been studied by Professor Hyatt in an original way. He finds that the gaps between forms or species may be largely explained by the later mode of development if the necessary care is taken to study the earlier stages, which should show the close genetic connection of the distinct adult forms, and explain thereby the absence of the intermediate varieties. For example, by carefully observing these principles it is possible to trace the entire family of *Arietidæ* to one original variety of one species—the smooth variety of *Psiloceras planorbis.* He finds that a series of species has, like an individual, a certain store of vital power, which enables it for certain periods, more or less prolonged, to evolve new forms and new characteristics, but which in the end fails; and in place of further progress in that direction we find an evolution of degraded forms, which compare exactly with the retrograde metamorphoses of the individual.

M. Pérez has published some researches on the mode of fecundation of the eggs in gasteropod mollusks, particularly the land-snails, while M. Dubrueil has finally completed his physiological studies on the genital apparatus of *Helix.*

The embryology of the Ascidians has been studied by Professor Giard. He finds a curious assemblage of parasites on the compound Ascidians of the coast of France, and some interesting cases of mimicry. A shell-fish (*Lamellaria*) and a naked mollusk (*Goniodoris*), a flat worm (*Planaria*), as well as a sponge, imitate these Ascidians so completely that the illusion is, he says, perfect. He also finds that certain compound Ascidians mimic simple ones.

Drs. Metschnikoff and Nitsche have been publishing on the development of the *Polyzoa;* while Dr. Smitt, of Stockholm, has completed his account of the deep-sea forms dredged by Count Pourtalès in the Floridan Channel. He finds that some species are cosmopolitan in range, while others have survived from the cretaceous period.

The development of the Brachiopoda has been studied by Kowalevsky, and, independently of Professor Morse, he has arrived at quite similar results, both in matters of detail and general conclusions. He thinks, with Morse, that these animals, heretofore classified with the Mollusca, are really allied to the Chætopod worms.

The singular fact is brought out in Claparède's remarkable posthumous work on worms that in several families (*Serpulidæ*, *Ammocharidæ*, *Aricidæ*, and *Chætopteridæ*) the intestine is inclosed in a vascular sac, which acts as a dorsal vessel, there being no true heart. This reminds one of the Mollusca in which the intestine normally passes through the heart.

The higher worms of the coast of New England have been enumerated, and many new and interesting forms described and figured by Professor Verrill, in his report on the invertebrates, published as an appendix to Professor Baird's United States Fish Commission Report.

A singular fact in the structure of some of the higher worms (annelids) has been observed by Professor Moebius, who figures a species (*Leipoceras uviferum*) with external ovaries. Another worm has been said by Sars to carry its eggs in pouches resembling a swallow's nest along the hinder segments of the body. Other anomalous modes of carrying the eggs are noticed in the same paper.

Dr. Willemoes-Suhm states his belief that the asexual Guinea-worm (*Filaria medinensis*) has possibly males of mi-

nute size, as in an allied worm (*Ichthyonema*) studied by him; though he adds that, like *Ascaris nigronenosa*, the Guinea-worm may be asexual, and related to another free-living, sexual generation of worms.

The dog is sometimes infested in China and Japan by a long, slender worm allied to the Guinea-worm, and described by Dr. Leidy under the name of *Filaria immitis*. In two cases lately reported in English journals the dogs died "after three days of great suffering," and it was found on examination that the ventricles and auricles of the heart were completely blocked up by the presence of a large number of these worms.

Little has been known of those singular creatures called "hair-worms" beyond the fact that in their early tadpole-like stage they somehow get into the bodies of various kinds of insects, notably grasshoppers, within whose bodies they are found coiled up. M. Villot has published the first part of a monograph on the hair-worms. They are oviparous, laying numerous minute eggs agglutinated by an albuminous substance, and forming long white strings. The young are parasitic, and pass through a number of metamorphoses, and at different stages live in different animals, as, for example, in one stage encysted in the aquatic larvæ of flies, and afterward again in the mucous layer of the intestines of fishes.

For twenty years a singular parasite of the oyster has been known in Europe under the name of *Bucephalus Haimeanus*. A similar species has been found in the oyster at Charleston, South Carolina, by Professor Macrody. The sporocysts and cercaria-like young of the European worm have long been known, but M. Giard has found that these young are encysted in the *Belone vulgaris*, a fish found on the French coast. He supposes that the encysted worm finally passes into another fish (*Gasterostomum*), which serves as food for the former larger fish.

A very interesting and popular article on parasitic worms, by Professor P. J. van Beneden, appears in *La Revue Scientifique*. A paper of value on the *Turbellaria* is published by Dr. Graff.

A singular worm-like being (*Peripatus*), referred by most observers to a separate order of worms, has been studied alive, and in its early stages, by Mr. Moseley, of the *Challenger*

expedition, while stopping in Australia. It seems that the young possess tracheæ, which open out by a large number of pores in the side of the body, so that it belongs among the Tracheata, or insects. It differs radically again from them by having the two main nervous cords widely separated, so that, though it has been proved not to be a worm, it remains almost as much of a puzzle as ever. Moseley shows that it has affinities to the true six-footed insects and myriopods, or thousand legs. He also enters into some speculations as to their ancestry.

An addition of much value to our knowledge of the mode of growth of crustacea is afforded by a Russian embryologist, Dr. Bobretzky. He figures the early stages of the pill-bug, or *Oniscus murarius*, of Europe.

The mode of moulting of the lobster is for the first time described in the *American Naturalist*. It is thought after attaining its full size only to moult once a year, at some period between May and November. On November 8th one was observed to cast its skin. It drew its body out of a rent in the carapace, or shell covering the front division of the body. The shell splits from its hind edge as far as the base of the rostrum or beak, where it is too solid to separate. The body is drawn out of the anterior part of the carapace. It has been a question how the creature could draw its big claw out through the small basal joints. The claw—soft, fleshy, and very watery—is drawn out through the basal joint without any split in the old crust. In moulting, the stomach, with the cartilaginous masses and bands, is cast off with the old integument. The length of the animal observed before moulting was six and a half inches; immediately after, seven and a quarter—an increase of three quarters of an inch.

Mr. S. J. Smith finds in the tube-building Amphipods certain glands, not before known to exist, which secrete the cement by means of which the tubes or homes of these animals are built.

An extended and beautifully illustrated memoir, by Weismann, on the structure of *Leptodora hyalina*, a little European Entomostracan, or water-flea, has just appeared. A translation of a summary of his previously published essay on the metamorphosis of the flies has been published in the *American Naturalist*.

Interesting new crustacea have been dredged by the *Challenger* party, including a blind, deep-sea Astacus-like form, and a *Tanais*, also blind, together with a new *Nebalia* from the Bermudas. Mr. Harger describes a new crustacean from Lake Superior under the name of *Asellopsis*, differing in some important characters from the common fresh-water "sow-bug," *Asellus*. A number of new Phyllopod crustacea have been described by Dr. Packard in the Sixth Report of the Peabody Academy of Science; and he gives a synopsis of the American forms in the Annual Report of Hayden on the Geology of the Territories, with remarks on their singular habits and distribution. The fossil crustacea of Bohemia have been further discussed by Barrande in a new volume of his Paleontology. A number of remarkable trilobites, and other ancient crustacea allied to the modern *Nebalia*, are described and figured.

The mass of published matter on the Insects, or Tracheata, is enormous, especially the systematic works and shorter papers. Perhaps the most important paper relating to the physiology of insects is one by Plateau on the phenomena of digestion, the result of a great number of dissections and experiments. He finds that when the salivary glands are not diverted from their primitive function to become silk or poison glands they secrete a neutral or alkaline liquid, possessing, at least as regards one pair, the property characteristic of the saliva of vertebrate animals of rapidly transforming starch matters into soluble and assimilable glycose. The change is effected in a posterior dilatation of the œsophagus. At this place results, in the carnivorous insects, a transformation of albuminoid matters into soluble substances like peptone; and in vegetable-feeding species an abundant production of sugar out of the starchy matters eaten. When digestion has taken place in the œsophagus, it is submitted to an energetic pressure in the gizzard, or proventriculus, which is armed with teeth. It thus seems that this is not an apparatus for crushing the food, but for expressing the liquid from the food triturated by the jaws. In the stomach, or middle intestine, as Plateau calls it, the food is again submitted to the action of an alkaline or neutral liquid, secreted by local glands, present in the *Orthoptera*, or by a great number of small glandular cœcua, as in many beetles, or by

a simple lining of epithelial cells. This fluid has no analogy with the gastric fluid of vertebrate animals. Its function differs according to the group to which the insect belongs. In the carnivorous beetles it makes an emulsion of the greasy matters; in the Hydrophilid beetles it continues the conversion of starch into glycose, begun in the œsophagus. In the caterpillars of the butterflies and moths it determines a production of glycose, and makes an emulsion of greasy matters; and in the grasshoppers no sugar is formed in the intestine, as this material is produced and absorbed in the œsophagus (*jabot*). The intestine proper is only a fœcal reservoir. The urinary or Malpighian tubes sometimes secrete calculi. No bile has been found in the secretions of these tubes. A point of great importance is touched upon by the author, namely, the passage of the chyle from the stomach to the blood. It is well known that there are in Articulates no lacteals as in Vertebrates to effect this process. Plateau states that the products of digestion pass through the walls of the digestive canal by an osmotic action, and directly mingle with the blood.

At the last meeting of the American National Academy of Sciences, Professor A. M. Mayer exhibited an experimental confirmation of the theorem of Fourier, as applied by him in his propositions relating to the nature of a simple sound, and to the analysis by the ear of a composite sound into its elementary pendulum-vibrations; and showed experiments elucidating the hypothesis of audition of Helmholtz. Placing a male mosquito under the microscope, and sounding various notes of tuning-forks in the range of a sound given by a female mosquito, the various fibres of the antennæ of the male mosquito vibrated sympathetically to these sounds. The longest fibres vibrated sympathetically to the grave notes, and the short fibres vibrated sympathetically to the higher notes. The fact that the nocturnal insects have highly organized antennæ, while the diurnal ones have not, and also the fact that the anatomy of these parts of insects shows a well developed nervous organization, lead to the highly probable inference that Professor Mayer has here given facts which form the first sure basis of reasoning in reference to the nature of the auditory apparatus of insects.

The external breathing apparatus of aquatic insects, called

tracheal gills, have hitherto been known to exist in the adult, winged state of but one genus of insects (*Pteronarcys*). Dr. Gerstaecker now finds that an European Nemoura and a Siberian and Chilian genus of stone-flies also possess them.

For about a month during the last part of April and early in May last Dr. Packard was engaged in exploring the caves of Kentucky under the auspices of the Geological Survey of that state, Professor Shaler director. He first examined the Mammoth Cave, and doubled the number of animals known to exist therein, and in others adjoining. An exploration with Professor Shaler of the Carter Caves in Grayson County, Kentucky, also revealed a rich fauna composed of twenty species. Dr. Packard also examined Wyandotte Cave alone, and found a wingless Psocus and two species of Thysanura, new to the cave. Several caves within sixteen miles of New Albany, Indiana, at Bradford, were examined in company with Dr. Sloan. Finally, a careful examination of Weyer's Cave, in Virginia, and the adjoining Cave of the Fountains, revealed a fauna containing some twenty species, no life having been previously reported from those caves. The most important discoveries were the larvæ of the blind beetles, *Adelops* and *Anopthalmus*, and a new species of *Japyx*, a genus not before detected in the United States.

The results show a great uniformity in the distribution of life, more than would at first be expected, though these caves lie in a faunal region nearly identical as regards the external world; and the temperature of the caves is very constant. Still some notable differences occurred.

The phosphorescent organs of *Elater noctilucus* have been investigated recently by MM. Robin and Laboulbène, who state (*Comptes Rendus*, Vol. LXXVII., No. 8) that the light first appears in the centre, then spreads throughout. A yellow linear zone of adipose tissue at the exterior, at length becoming luminous, is yet not photogenic; it only reflects the light produced by the central part. But it does so not only from its internal face, but throughout its thickness, the action being favored by the transparency and high refringent power of the fatty globules. The phenomena of dispersion and interference thus produced are the cause of the remarkable brilliancy appearing when the light from the centre reaches as far as this zone. As to the changes of molecular

state in the tissue proper of the organ, the authors think the phosphorescent tissue produces a substance which slowly accumulates in the cells independently of all nervous influence, and of the same order with other secretions; and that only the act by which it is discharged is voluntary. The principle rendering the cells luminous behaved like the *noctilucine* extracted by Phipson. The abundance of urates in the cells makes it probable that uric acid results from the photospheric decomposition of the preceding coagulable compound. The large number of tracheæ in the apparatus is doubtless connected with the consumption of oxygen accompanying the phenomena.

The relation of insects to plants has been fully discussed by Hermann Müller, Professor Gray, Dr. Hooker, Sir John Lubbock, Dr. Mellichamp, Mr. Riley, and others, in various journals and newspapers, showing the great popular interest taken in the subject.

The application of entomology to agriculture is in the United States a matter of so much practical importance that several of the states (New York, Missouri, and Illinois) have salaried entomologists, whose reports are of great value. Particularly that of Mr. Riley, which is replete with new facts regarding the habits of injurious insects. It contains a long and condensed article on the Phylloxera of the vine, which will be of especial value to grape-raisers. Meanwhile every pains is being taken in France to find out means of preventing the attacks of this formidable pest, which has hitherto baffled every attempt to reduce its numbers. Dr. Lebaron's report on the insects of Illinois is taken up with an account of the beetles, and will be the means of creating much interest in the study of insects. The grasshopper of the West has done incalculable damage in Minnesota and parts of Kansas and Nebraska; and it is to be hoped that our entomologists will, from a study of its habits, be able to devise some way of meeting its attacks with fair success. The army worm of the South has been studied in Alabama by Mr. Grote. He attempts to show that the insect hybernates as a moth, and that it dies out in the central and northern portions of the cotton belt every year, being replaced the succeeding year by immigration from more southern localities, and where the cotton plant is perennial.

The habits of the white ants have been studied by Fritz Müller in Brazil. Besides the winged males and females, which are produced in vast numbers, there are wingless males and females which never leave the nest, and which replace the winged males or females whenever a community does not find in due time a true king or queen. Besides this, in some species there are two sets of workers, *i. e.*, laborers and soldiers, as stated by Smeathman, so that we have six kinds of individuals in a species.

A fossil *Cicada* has been found in the Miocene tertiary formation of Europe by M. Saporta. It is the first fossil species found, and belongs to a genus now confined to Southern Africa.

Sir John Lubbock questions the truth of the theory that insects have a language, and concludes that they do not communicate their discoveries to each other. He states that, as far as his experience goes, bees which have stung and lost their stings always die. They are much affected by light. "One evening," he remarks, "I lighted a small covered lamp to go down to the cellar. A bee which was out came to it, and, flying round and round like a moth, followed me the whole of the way there." It is clear, he states, that bees can distinguish colors. He found that bees would never take any notice of the many different noises he made to attract their attention. The temper of bees is very variable, generally not irritable; at other times they stung him several times a day, and "seemed the more prone to do so the hotter the weather." Wasps are as busy as bees. They are as insensible to sounds as bees.

The most important embryological paper of the year on insects is one, beautifully illustrated, by Metschnikoff, on the development of the thousand-leg Myriopods. He finds a close resemblance in their development to that of the Podura. The egg undergoes total segmentation. We had previously no observations of any value on the growth in the egg of this sub-class of insects. The Myriopods of Mexico have been described by De Saussure and Humbert.

The first volume of an elaborate and very useful work on the spiders of France, by M. Simon, with some excellent plates, will interest American students of these neglected animals. Some interesting notes on the habits of web-building spiders have been given out by Professor Wilder.

Among insects, the most important systematic work perhaps that has appeared during the year is an essay on the classification of the weevils (*Rhynchophora*) by Dr. Leconte, published in the *American Naturalist.* He regards this extensive group of Coleoptera, usually mentioned as a single family, as susceptible of division into three series, each divisible again into a number of families. A good many new moths, *Neuroptera*, and other insects, have been described in this country, and European journals and transactions teem with diagnoses of new forms of all orders.

Coming now to the Vertebrates, we have a paper, of which an abstract has been published by Mr. Balfour, on the embryology of sharks. He makes the statement that the nervous system is developed from the inner germ-layer, instead of the outer, as in all other vertebrates so far as known. This discovery will throw further doubt on the value of Haeckel's "*Gastræa*" theory.

According to Professor Semper, the embryos of the rays and sharks have segmentary organs like those of the annelides. Vogt regards this fact as a further indication of a relationship between the vertebrates and invertebrates.

The genus *Ceratodus*, which was formerly supposed to have become extinct at the close of the Triassic period, but which was a few years ago, to the astonishment of all naturalists, found to be represented by living allies in Australia, has lately had a new addition (*C. Palmeri*) made to it from the alluvial deposits of Queensland. The species is larger than its living relations. This discovery goes a short (and very short) way toward filling up the great chronological gap which intervenes between the extinct European species and the living Australian ones.

Dr. Günther has recently examined a considerable collection of the remains of tortoises found in the islands of Mauritius and Rodriguez, associated with the bones of the dodo and solitaire, and has arrived at the following conclusions:

1. These remains clearly indicate the former existence of several species of gigantic land-tortoises, the Rodriguez species differing more markedly from those of the Mauritius than these latter among themselves. All these species appear to have become extinct in modern times.

2. These extinct tortoises of the Mascarenes are distin-

guished by a flat cranium, truncated beak, and a broad bridge between the foramina obturatoria.

3. All the other examples of gigantic tortoises preserved in our museums, and said to have been brought from the Mascarenes, and likewise the single species which is known still to survive, in a wild state, in the small island of Aldabra, have a convex cranium, truncated beak, and a narrow bridge between the obturator foramina; and therefore are specifically, if not generically, distinct from the extinct ones.

4. On the other hand, there exists the greatest affinity between these contemporaries of the dodo and solitaire and the tortoise still inhabiting the Galapagos archipelago.

These unexpected results induced the author to subject to a detailed examination all the available material of the gigantic tortoises from the Mascarenes and Galapagos which are still living, or were believed to be living, and are commonly called *Testudo indica* and *Testudo elephantopus*, and to collect all the historical evidence referring to them. Thus in the first (introductory) part of the paper a selection from the accounts of travelers is given, by which it is clearly shown that the presence of these tortoises at two so distant stations as the Galapagos and Mascarenes can not be accounted for by the agency of man, at least not in historical times, and therefore that these animals must be regarded as indigenous.

A finely illustrated work on the Cetaceans and Pinnipeds of the Pacific Ocean has been published by Captain Scammon, which gives many interesting and original statements regarding their habits.

Professor Marsh has presented an interesting contribution to natural history in a paper upon the genesis of the horse, as based upon his own observations in the Rocky Mountains. He finds the sequence unbroken through six or eight forms, and in succeeding geological ages from the Eocene *Orohippus* down to the *Equus* of the modern epoch.

The birds have continued to engage the attention of naturalists. A good many specimens have been collected by our Western expeditions. Dr. Yarrow has published a list of those obtained by himself and Mr. Henshaw on Wheeler's expedition in Utah and Nevada. The most notable ornithological publication of the year is Messrs. Baird, Brewer, & Ridgway's

"History of North American Birds," as no such comprehensive work has appeared since the publication of Audubon's "Birds of America." A number of short papers on the distribution and habits of North American birds, by Dr. Coues, Messrs. Ridgway, Brewer, Henshaw, Allen, and Lawrence, have appeared in various journals, etc. The English *Ibis* and Cabanis's German journal of ornithology are filled with new matter relating to this department, and shows that the very general interest taken in birds is unabated.

Professor Peters finds new coincidences between the development of the *Cœciliæ* and other Batrachians. He states that these creatures possess neither amnion nor allantois, that they are, at least in part, viviparous, and that at a certain period of the year they are aquatic.

That the common striped snake (*Eutænia*) and allied genera are viviparous had been well known, but Professor Cope has discovered that the snakes of the genus *Storeria* also bring forth their young alive. He also describes a fossil lizard from the Miocene formation of Colorado. He calls it *Peltosaurus*, and says that it is a member of a family of lizards still existing in Mexico and California. He also describes a number of Batrachians and *Nematognathi* brought from the Upper Amazon by Professor Orton. The Cuban crocodile, already known as an inhabitant of Eastern Florida, has now been found in Western Florida by Mr. Maynard.

A recent list by Dr. Gundlach of the Mammals of Cuba invites renewed attention to the remarkable paucity of species in that island. Of twenty-four kinds enumerated, nineteen are bats, the remainder being made up of one *Solenodon* (an insectivorous mammal), three species of *Capromys* (porcupine-like rodents), and one manatee.

Mr. E. R. Lankester, in referring to what has been called the recapitulation hypothesis, and applying this to the human race, remarks that the earliest commencement of a human being was a small speck of protoplasm of mucus-like consistency, such as existed in ponds. A later stage exhibited him as a small sac, composed of two layers of living corpuscles, which he inherited from polyp-like ancestors, and was to-day seen in polyps. Still later he was an elongated creature, with slits in the side of the neck, which, like the gill-slits of a shark, he inherited from a shark-like ances-

tor. Six months after birth the child continued to inherit qualities from its ancestors, viz., from those which crawled on four legs; and at a later period certain irrepressible tendencies made it clear that qualities were inherited from climbing and shrieking animals.

Perhaps the most interesting form of mammals discovered recently is a peculiar rodent of the Hystricoid type, most resembling in external characters the common paca (*Cœlogenys paca*), but differing so much in osteological characters from all other forms that it has been isolated by its describer (Professor W. Peters) as a distinct family: it has been named *Deinomys branchii.*

The squirrels of North America have been undergoing revision by Mr. J. A. Allen. Professor Baird, in a monograph of the group published in 1857, reduced the number of species of the genus *Sciurus* alone from twenty-four—the number recognized by Audubon and Bachman in 1854—to ten well-established species and two doubtful ones. Now Mr. Allen finds so much variation in the group as to be obliged to reduce the specific forms to five, "recognizing, however, seven geographical varieties in addition, making the whole number of recognized forms twelve."

Mr. Tomes's studies of the development of the teeth in the armadilloes have verified the inference, based on other evidences, that they, in common with the other edentates, have descended from a diphyodent type of mammals, in which the teeth were invested in enamel, inasmuch as in the earliest stages of their dentition differentiation is manifested by the formation of an "enamel organ" as in typical mammals, and behind these primitive teeth rudimentary sacs are found, which are evidently homologous with the germs of the second or permanent series of teeth.

Professor Gill has elucidated some interesting features affecting the relations of North American mammals in regard to each other, as well as to foreign forms. In studying the various species of deer, he has found that the common small American species exhibit many differences in contrast with the characters developed in the American elk and the English red-deer; these are furnished not only by the antlers, but also in details of the skull, as well as the development of the feet; the differences seen in the last are so curious as

to deserve notice here. As somewhat previously indicated by Sir Victor Brooke, in the common Virginian and black-tailed deers and their allies, the lateral metacarpal bones are atrophied at their proximal extremities and are well developed at their distal; on the other hand, in the so-called elk and the red-deer of Europe, the corresponding parts are developed at their proximal extremities and atrophied at their distal. In these characters the smaller deer agree with the reindeer and the moose. The large deer are now alone retained in the genus *Cervus;* for the small ones, *Cariacus* of Gray is used.

It is doubtless known to most of our readers that two kinds of foxes are found in North America—the red foxes (including the varieties and sports from that form) and the gray foxes. All of these have hitherto generally been combined under a single genus, *Vulpes*, but Professor Baird long ago distinguished in this genus two groups for the reception of these several forms, retaining the name *Vulpes* for the red foxes, and proposing the name *Urocyon* for the gray ones. Professor Gill has lately found that these forms are, however, but distantly related, and considers that the gray foxes are allied to *Nyctereutes*, and some other forms, and more remotely to the singular African genus *Megalotis*, while the red foxes are very nearly related to the dogs and wolves. He therefore combines the red foxes and wolf-like forms in one group, contrasted with the gray foxes.

Among other publications on the mammals may be enumerated the Milne-Edwards' "Recherches sur les Mammiferes," now completed; and various articles by Sir Victor Brooke, W. Busk, J. E. Gray, Sinhoe, etc.

BOTANY.

Botanical progress in America shows the completion of no work of very marked importance. Dr. Asa Gray has continued his "Contributions" in the Proceedings of the American Academy, consisting of notes upon various genera of Composites, including especially a revision of the genus *Cnicus* and followed by a review of the orders *Borraginaceæ* and *Solanaceæ*. The American *Chenopodiaceæ* have also been revised by Sereno Watson in the same Proceedings. Dr. John Torrey's report, prepared long before his death,

upon the collections made on the western coast by the Wilkes Exploring Expedition has at length been published by the United States Government, under the editorship of Dr. Gray. It forms a large quarto volume, and is illustrated by a number of finely engraved folio plates.

A Flora of Colorado has been published in connection with Professor Hayden's reports, prepared by Professor T. C. Porter and Dr. J. M. Coulter. Notes by Dr. C. C. Parry upon the botany of Western Wyoming, with descriptions of new species, the result of his collections the previous year in that region, and by Dr. J. G. Cooper upon the botany of the Cuyamaca mountains in Southern California, have appeared in the "American Naturalist," with articles by Dr. F. Brentnel on the distribution of oaks and the origin of the vegetation of Florida. Catalogues of Lieutenant Wheeler's collections, made in 1871–73 in Southern Nevada and eastward to Colorado, add somewhat to the knowledge of the plants of that section. A catalogue of the plants of New Jersey has also been published by O. R. Willis, with notes upon many of the species.

In Europe, among the English botanists, Dr. J. D. Hooker has finished the second part of the Flora of British India, in which he was assisted by Edgeworth, Masters, Dyer, and others, and which continues the polypetalous orders through the *Geraniaceæ.* J. G. Baker has made revisions of the *Tulipeæ,* including the numerous American species of *Calochortus, Fritillaria, Lilium,* etc., and of the Asiatic species of the genus *Allium,* while the fungi of Ceylon have been elaborated by Berkeley and Broome. The collections made on the *Challenger* expedition by Mr. Moseley at various islands in the Atlantic Ocean, from the Bermudas to Kerguelen Land, have been carefully worked up, and the results have appeared in the Journal of the Linnæan Society. In France, M. Baillon has continued his "Monographies" by one upon the genera of the *Saxifragaceæ,* in which he includes the *Plataneæ;* Franchet and Savatier have begun an enumeration of the plants of Japan, assisted by Maximowicz of St. Petersburg; and M. Planchon has made a study of the vine and its enemy, the *Phylloxera,* visiting the United States for the purpose. An interesting essay by Alphonse de Candolle proposes the division of the vegetable kingdom into certain

physiological groups, which he supposes to have been determined by secular changes of temperature in the earth's climate.

A Flora of Norway has appeared from the hands of Axel Blytt, of Stockholm; and that of Spain, commenced some years ago, has been continued by Willkom and Lange. In Germany, the few systematic botanists have shown their usual diligence. The elaboration of the *Euphorbiaceæ* of Brazil has been completed for Martius's "Flora" by J. Müller, to which also the *Polygalaceæ* have been contributed by A. W. Bennett. The *Pomareæ* have been revised by Dr. Wenzig in the "Linnæa," and the *Cyperaceæ* of the Berlin Herbarium by Böckeler; while in the "Flora" Wawra has continued his Flora of the Hawaiian Islands. Of the Russian botanists, Maximowicz has published additional contributions to the flora of Japan and Eastern Asia, making frequent reference to the allied American species; the Oriental *Labiatæ* have been worked up by Bunge; and the genus *Vitis* has been again the subject of a monograph by Dr. Regel.

Much attention has been given during the year to the investigation of those plants which are known as insectivorous, and much light has been thrown upon the whole subject. Mr. Darwin and Dr. Hooker, in England, have paid especial attention to the sundews and Asiatic pitcher-plants (species of *Drosera* and *Nepenthes*); and in this country the Sarracenias have been studied by Dr. Mellichamp, the Dionæa by Mrs. Mary Treat, and the Darlingtonia and Droseras by Mr. W. M. Canby. It seems clearly established that these various plants are in their different ways constructed expressly for the entrapping of insects, and that the prey passes through a process of digestion and absorption, apparently for the sole purpose of the nourishment of the plant.

Work in anatomical and physiological botany has been confined chiefly to the botanists of Germany and France, though two important papers have been published in America. One of these is by Dr. W. G. Farlow upon the occurrence in some ferns of an asexual growth from the prothallus, the plant being reproduced from the spore without the formation of the ordinary sexual organs. Dr. Gray notes that this should probably be considered a case of parthenogenesis, going to prove, if the facts hold good, in connection with a

few analogous cases in phænogamous plants, that sexual fertilization, however necessary, is not absolutely necessary in every generation of plants. The second article is upon the circulation of sap in trees, by W. S. Clark, President of the Massachusetts Agricultural College, showing the results of numerous and long-continued observations made at that institution upon the bleeding of trees, the character of the sap, and the amount of pressure exerted at different heights in the trunk and at different seasons, and also in the roots. Most notable among foreign publications is the French translation, by Van Tieghem, of Sach's great work upon "Vegetable Physiology and Anatomy," made from the third and latest edition, and largely annotated, thus embracing all recent discoveries, as well as expressing directly the views of the two highest authorities in this department. Chatin has contributed to the "Annales des Sciences" an important article upon the development of the ovule and seed in several of the monopetalous orders, while the structure of the seeds in the *Rafflesiaceæ* and *Hydnoraceæ* has been investigated by Count Solms-Laubach (in the "Botanische Zeitung"), confirming the conclusions of Robert Brown respecting the affinities of the first order, but leaving those of the latter still uncertain. The comparative anatomy of the *Gnetaceæ* and *Coniferæ* has been treated by Bertrand in the "Annales," and the structure of the cell-wall in *Pinus sylvestris* by Dr. Karl Sanio in an extended paper in Pringsheim's "Jahrbücher," whose conclusions are criticised and to some extent controverted by Dippel in the "Flora." Fleischer, in the same journal, in a comparison of the embryo of monocotyledonous and of dicotyledonous plants, shows that the distinct character of the two forms exists from almost the earliest cell-formation.

The relations and properties of chlorophyl have been the subject of papers by Chautard and Prillieux in "Comptes Rendus," and by Wiesner, Krause, and others. The circulation of gases and respiration in plants has been studied with interesting results by Barthélemy, and by Dehérain and Moissau, while Haeckel has investigated the phenomena of plant-irritability in certain cases, and by the aid of anæsthetics has been enabled to demonstrate in what way motion is produced.

Collections in the field in our Western Territories have

been continued under the several government expeditions—by Dr. Rothrock, in Arizona; by Coues, on the northern boundary; by Dall, in the Aleutian Islands; and by others. The only collection as yet critically examined is a private one made by Dr. C. C. Parry in Southern Utah, containing much of interest, as well as several new species. A list of all the new North American species published during the year, a hundred in number, is here added.

List of newly discovered species of North American plants described in 1874, excepting the lower cryptogams:

Clematis Scottii. PORTER, Flora of Colorado, p. 1.
Aquilegia Jonesii. PARRY, Amer. Naturalist, p. 211.
Ranunculus oxynotus. GRAY, Proc. Amer. Acad., vol. x., p. 68.
Ranunculus Lemmoni. GRAY, same, p. 68.
Dendromecon Harfordii. KELLOGG, Proc. Califor. Acad., vol. v., p. 104.
Corydalis Caseana. GRAY, Proc. Amer. Acad., vol. x., p. 69.
Draba ventosa. GRAY, Amer. Naturalist, p. 212.
Stanleya tomentosa. PARRY, same, p. 112.
Staphylea Bolanderi. GRAY, Proc. Amer. Acad., vol. x., p. 69.
Astragalus Pulsiferi. GRAY, same, p. 69.
Astragalus Grayi. PARRY, Amer. Naturalist, p. 212.
Astragalus ventorum. GRAY, same, p. 212.
Astragalus Parryi. GRAY, same, p. 212.
Astragalus Brandegei. PORTER, Flora of Colorado, p. 24.
Astragalus scopulorum. PORTER, same, p. 24.
Ivesia Webberi. GRAY, Proc. Amer. Acad., vol. x., p. 71.
Rosa Arkansana. PORTER, Flora of Colorado, p. 38.
Ribes Wolfii. ROTHROCK, Amer. Naturalist, p. 358.
Mentzelia Torreyi. GRAY, Proc. Amer. Acad., vol. x., p. 72.
Petalonyx Parryi. GRAY, same, p. 72.
Townsendia Parryi. EATON, Amer. Naturalist, p. 212.
Townsendia condensata. EATON, same, p. 213.
Erigeron glandulosum. PORTER, Flora of Colorado, p. 60.
Erigeron Coulteri. PORTER, same, p. 61.
Antennaria microcephala. GRAY, Proc. Amer. Acad., vol. x., p. 74.
Thelesperma subnudum. GRAY, same, p. 72.

Chænactis attenuata. GRAY, Proc. Amer. Acad., vol. x., p. 73.
Schkuhria integrifolia. GRAY, Amer. Naturalist, p. 213.
Disodia Cooperi. GRAY, Proc. Amer. Acad., vol. ix., p. 201.
Helenium amphibolum. GRAY, same, p. 202.
Helenium ooclinium. GRAY, same, p. 202.
Helenium laciniatum. GRAY, same, p. 203.
Helenium Curtisii. GRAY, same, p. 204.
Gaillardia acaulis. GRAY, same, vol. x., p. 73.
Senecio Greenei. GRAY, same, p. 75.
Cnicus quercetorum. GRAY, same, p. 40.
Cnicus Breweri. GRAY, same, p. 43.
Cnicus Arizonicus. GRAY, same, p. 44.
Cnicus Andersonii. GRAY, same, p. 44.
Cnicus Andrewsii. GRAY, same, p. 45.
Cnicus Parryi. GRAY, same, p. 47.
Microseris troximoides. GRAY, same, vol. ix., p. 211.
Glyptopleura setulosa. GRAY, same, p. 211.
Malacothrix Torreyi. GRAY, same, p. 213.
Malacothrix Xanti. GRAY, same, p. 213.
Malacothrix platyphylla. GRAY, same, p. 214.
Lygodesmia rostrata. GRAY, same, p. 217.
Senecio renifolius. PORTER, Flora of Colorado, p. 83.
Arnica Parryi. GRAY, Amer. Naturalist, p. 213.
Phelipæa lutea. PARRY, same, p. 214.
Orthocarpus Parryi. GRAY, same, p. 214.
Collinsia Greenei. GRAY, Proc. Amer. Acad., vol. x., p. 75.
Audibertia Clevelandii. GRAY, same, p. 76.
Saracha nana. GRAY, same, p. 62.
Physalis Wrightii. GRAY, same, p. 63.
Physalis hederæfolia. GRAY, same, p. 65.
Physalis Fendleri. GRAY, same, p. 66.
Cynoglossum occidentale. GRAY, same, p. 58.
Lithospermum Californicum. GRAY, same, p. 51.
Amsinckia echinata. GRAY, same, p. 54.
Amsinckia tessellata. GRAY, same, p. 54.
Eritrichium Torreyi. GRAY, same, p. 58.
Eritrichium oxycaryum. GRAY, same, p. 58.
Eritrichium fulvocanescens. GRAY, same, p. 61.
Gilia filiformis. GRAY, same, p. 75.
Gomphocarpus purpurascens. GRAY, same, p. 76.

Suæda diffusa. WATSON, same, vol. ix., p. 88.
Suæda Torreyana. WATSON, Proc. Amer. Acad., p. 88.
Suæda suffrutescens. WATSON, same, p. 88.
Suæda Californica. WATSON, same, p. 89.
Kochia Americana. WATSON, same, p. 93.
Chenopodium olidum. WATSON, same, p. 95.
Blitum Californicum. WATSON, same, p. 101.
Atriplex spicata. WATSON, same, p. 108.
Atriplex Alaskensis. WATSON, same, p. 108.
Atriplex monilifera. WATSON, same, p. 111.
Atriplex saccaria. WATSON, same, p. 112.
Atriplex Wolfii. WATSON, same, p. 112.
Atriplex Wrightii. WATSON, same, p. 113.
Atriplex Texana. WATSON, same, p. 113.
Atriplex coronata. WATSON, same, p. 114.
Atriplex Powellii. WATSON, same, p. 114.
Atriplex expansa. WATSON, same, p. 116.
Atriplex Greggii. WATSON, same, p. 118.
Atriplex oppositifolia. WATSON, same, p. 118.
Atriplex Breweri. WATSON, same, p. 119.
Eriogonum spathulatum. GRAY, same, vol. x., p. 76.
Eriogonum Parryi. GRAY, same, p. 77.
Salix lævigata. BEBB, Amer. Naturalist, p. 202.
Calochortus Benthamii. BAKER, Jour. Linn. Soc., vol. xiv., p. 304.
Calochortus apiculatus. BAKER, same, p. 305.
Calochortus Lyallii. BAKER, same, p. 305.
Scirpus Wolfii. GRAY, Proc. Amer. Acad., vol. x., p. 77.
Scirpus apus. GRAY, same, p. 78.
Carex tenuirostris. OLNEY, Amer. Naturalist, p. 214.
Vilfa minima. VASEY, Wheeler's Catalogue, p. 54.
Poa Wheeleri. VASEY, same, p. 55.
Festuca Thurberi. VASEY, same, p. 56.
Trisetum Wolfii. VASEY, same, p. 57.
Isoetes Bolanderi. ENGELMANN, same, p. 214.
Isoetes pygmæa. ENGELMANN, same, p. 214.
Isoetes Nuttallii. A. BRAUN, same, p. 215.
Campylopus Hallii. LESQUEREUX, same, p. 155.
Campylopus frigidus. LESQUEREUX, same, p. 155.
Riccia Frostii. AUSTIN, Wheeler's Catalogue, p. 62.
Riccia Watsonii. AUSTIN, same, p. 62.

AGRICULTURE.

In agricultural science we have to report an encouraging amount of progress. As usual, the majority of the more important investigations come from the European, and particularly from the German experiment stations, which are continually increasing in numbers, activity, and usefulness. In our own country, likewise, the past year has been marked by a number of very gratifying evidences of interest in this department of research. Among these may be mentioned the appearance of the *Bulletin* of the Bussey Institution, and a movement for the establishment of an experiment station in Connecticut.

The Bussey Institution, intended by the will of its founder for the advancement of agricultural science, and forming a branch of Harvard University, having at present no students, is devoting a considerable portion of its own resources, aided by donations from the Massachusetts Society for Promoting Agriculture, to experiments in agricultural chemistry. Under the direction of Professor Storer, a number of very extended and useful investigations have been made, and are still in progress, on the composition of feeding materials and fertilizers, the effects of different fertilizers upon crops, and kindred topics. The institution thus amounts practically to an experiment station.

At the meeting of the Connecticut Board of Agriculture in December, 1873, a movement toward the establishment of an experiment station in that state was initiated. After the matter had been canvassed in a number of farmers' meetings, held for the purpose in various parts of the state, a motion was brought before the Legislature providing funds for the establishment of a station. The bill was, unfortunately, deferred until the next Legislature. As the project has found hearty support among the intelligent farmers of the state, it is hoped that it may meet with success.

At the Massachusetts Agricultural College, investigations have been made by President Clark upon the flow of sap in trees. In the laboratory of the Scientific School at New Haven, Professor Johnson and assistants are engaged in some very interesting studies upon the nitrogen of soil.

The chief workers in agricultural science in England are

Messrs. Lawes & Gilbert, of Rothamstead, and Dr. Voelcker, chemist of the Royal Agricultural Society. At the establishment of Messrs. Lawes & Gilbert, consisting of a laboratory and experimental fields, some eight or ten persons are directly or indirectly engaged in experimental researches, the total expense of which, amounting to two thousand pounds (£2000) per annum, is borne by Mr. Lawes. Some of the most elaborate investigations known in agricultural science have been performed here. Among these are experiments upon the nutritive value of different foods for cattle, and upon the effects of different manures upon different crops grown year after year upon the same land. A late report of a series of experiments upon the growth of barley for twenty years in succession upon the same land fills 197 pages of the Journal of the Royal Agricultural Society. In the laboratory of Dr. Voelcker, which occupies four stories of a house in Salisbury Square, London, some five or six assistants are employed, and as many as two hundred analyses of fodder materials, and nearly two thousand analyses of fertilizers, are made per annum.

In the experiment station founded by Grandeau at Nancy, in France, considerable good work is being done. Of the labors of the other experiment stations reported as having been founded in France we hear but little.

Accounts from Switzerland show that there are in that country, 1st, the so-called "Alpine Experiment Stations," four in number, commenced in 1863, for the purpose of making experiments with fertilizers; 2d, a station for dairy economy, established in 1872, at Thun; 3d, a station in process of establishment in connection with the agricultural department of the Polytechnic School at Zurich; 4th, the establishment for investigations in agricultural science, maintained by Mr. Risler on his estate of Calèvres, near Nyon.

The progressive spirit which prevails in Italy under the *régime* of Victor Emmanuel has effected, among other improvements, the establishment of some twelve experiment stations. Of these, one is devoted to investigations on silk-culture; another to wine-culture; another to dairy economy; while the labors of others, instead of being specialized, are devoted to various branches of investigation.

In January, 1873, a meeting of the directors of the stations

was held at Rome, in which reports were made and discussions held upon experiments on sugar-beet culture, and upon the growth of maize and wheat; the management of silkworms; grape-culture and wine-making; and similar subjects. We have reports of the continued and successful activity of these stations, and of the establishment of others by private enterprise.

The Austrian government, through its ministry of agriculture, has likewise caused the establishment of a number of experiment stations, and provided funds for their successful maintenance.

It is in Germany, however, that by far the greatest amount of research in agricultural science is made. The first experiment station was established in Saxony about twenty-one years ago. There are now in the German Empire some forty, of which several have been established during the past year. In each one of these stations from one to six persons are engaged in the work of investigation. With these should be reckoned a number of laboratories, connected with agricultural schools, and devoted to work in agricultural chemistry. An idea of the character of the later researches in animal and vegetable chemistry and physiology may be gained from the transactions of the Section for Agricultural Chemistry of the meeting of the German *Naturforscher und Aerzte* held at Wiesbaden last September, at which nearly forty persons, including the directors and chemists of a number of the stations, were present, and some of the more important labors of the stations were reported.

Dr. Von Wolff described a number of series of experiments on the digestive capacity of swine for various fodder materials, as barley, maize, beans, pease, cocoa-nut cakes, and even cock-chafers (*Maikaefer*), which latter were found to be quite nutritious. The high digestive power of swine for carbohydrates was strikingly demonstrated. Experiments on the digestive capacity of sheep for hay and turnips were also reported.

Dr. Fleischer gave accounts of new respiration experiments with sheep, performed at Weende, in continuation of a series which has been going on for some years at that station. Weiske and Weldt reported experiments showing that more hippuric acid was excreted by rabbits when fed on clover than when fed on pure grass.

Dr. Mayer, of the University of Heidelberg, described experiments on the absorptive power of leaves from ammonia, from which it appeared that, contrary to the usual belief, leguminous plants have no special facility for absorbing combined atmospheric nitrogen.

Dr. Von Wolff reported experiments on the effects of different amounts of phosphoric acid on the development of oat plants grown in aqueous solutions.

Besides the experiments here referred to, a large number of investigations upon the nutrition of animals and plants, and allied subjects, have been in progress in the German stations during the past year. Among the most important of these researches are those upon the functions of the different ingredients of food in animal nutrition, which are carried on by means of the respiration apparatus.

The sources of supply and the means of regulating the sale of commercial fertilizers are subjects of ever-increasing interest. Examinations of the deposits of Peruvian guano are calculated to relieve the fears of those who were anticipating a speedy exhaustion of this article.

The analyses of fertilizers, for the purpose of control of the trade in these articles, are becoming year by year more common, and their necessity better understood. In the experiment station at Halle, in Germany, the number of these analyses made annually has been increasing, until now it is over one thousand. In the laboratory of Professor Voelcker, of London, chemist of the Royal Agricultural Society of England, where analyses of fertilizers are made for members of the society and others, the amount of this work has grown to such a degree that five or six assistant chemists are employed, who analyze about two thousand samples per year. Professor Goessman, of the Massachusetts Agricultural College, has been appointed inspector of fertilizers for that state. His first report has appeared, and is a very valuable pamphlet upon the sources of supply and quality of the more important fertilizing materials used in Massachusetts. The Report for the Connecticut Board of Agriculture for 1873 contains the report of Professor Johnson on the analyses of thirty-one fertilizers in common use in the state. A report by Professor White on the analyses of fertilizers sold in the State of Georgia is also worthy of mention. While the

analyses above referred to show an improvement in the quality of the fertilizers over that of former years, they still confirm the results of experience, as decisive as it is costly, in Europe and in the United States, that the only means for regulating the trade in commercial fertilizers, and preventing immense frauds, is that the buyers know the quality of the goods they purchase, and that this can be determined only by chemical analysis.

FISHERIES.

Under the head of *Pisciculture* and the *Fisheries* we have to record continued and satisfactory progress in the efforts made to increase the food supply for the United States and elsewhere, the combined action of several of the states and of the general government having produced most gratifying results. Owing to the late period at which the Congressional appropriation for the purpose was made, the hatching and distribution of shad on the part of the United States could not be begun until the end of June, when, of course, the Southern stations were unavailable for the purpose. Arrangements were made, however, with the Fish Commissioners of New York and Connecticut to furnish a supply of young shad from the Hudson and the Connecticut rivers, and the labor of transfer was continued until the middle of August. Several millions of young fish were successfully transferred to remote points, in one instance as far as Texas, while Minnesota, Iowa, Wisconsin, Illinois, Ohio, Kentucky, Vermont, and Maine shared in the results.

The fish are usually placed in the head-waters of the streams, where they remain for a certain period, and then pass down to the sea. On their return, the states bordering on the rivers along the entire line of their route have an equal chance to participate in the benefits of their introduction.

As a return for the courtesy extended by the German government two years ago in presenting 250,000 salmon-eggs to the United States, the attempt was made to send a number of young shad to that country. Messrs. Mather & Anderson, experienced fish-culturists, were placed in charge of 100,000 fish, and free passage and freight furnished by the North German Lloyds, on the steamer *Rhine*. Unfortunately, the fish did not survive the eleventh day out, having

died, apparently for want of proper food, shortly before reaching Southampton, much to the disappointment of the people of Germany, who had hoped for better results. It is probable, however, that the experiment will be renewed another season, and it is to be hoped with full success.

The collecting of salmon at the United States establishments has also been very successful. In California, Mr. Livingston Stone renewed his operations on the McCloud River, and obtained six millions of eggs, of which number one million were hatched and placed in the Sacramento River, and the rest were shipped to the East, where they were given in charge of the Fish Commissioners of many of the states for hatching out and distribution. This has been already done to a large extent, and will doubtless produce important results. The distribution in this case was very much the same as in that of the shad.

At the other establishment at Bucksport, on the Penobscot River, in charge of Mr. Charles G. Atkins, more than three millions of eggs were taken, which are now being developed to the proper stage for distribution.

An experiment was made by the United States Fish Commissioner, in connection with those of Massachusetts and Connecticut, to secure a supply of Land-locked Salmon, a superior species for certain localities. Owing to untoward circumstances, a less number than had been hoped for was obtained, although enough to allow a limited distribution.

The American Grayling (*Thymallus tricolor*) has been a subject of attention on the part of several specialists, by whom both fish and eggs have been brought from the Au-Sable River, in Michigan, where they are very abundant. Although this fish is of little economical value, it is one of great beauty, and has excellent game qualities, so that it is considered desirable to multiply it.

Black Bass and other interior fish have also been distributed by various State Commissioners, so as to greatly widen their present range.

It is almost too early to judge of the results of the introduction of shad into new waters, although there is reason to believe that the experiment in California will be a success, full-grown fish having been taken during the last season. The species is protected from capture for several years to

come by legislative enactment. Similar indications of the occurrence of nearly full-grown shad in Lake Ontario have also been recorded.

The experiment of transferring salmon to New Zealand and Tasmania has not been satisfactory heretofore, and it is proposed to renew it by means of spawn sent from England, as also from California. The success in introducing the European Trout and Yellow Perch has, however, been perfect, both these species being now taken by the ton in the waters of the countries first mentioned.

The increasing interest in the general subject of fish-culture is shown by the number of states now provided with Fish Commissioners to look after this interest within their respective limits; and it is probable that during the present winter many of the remaining states will be provided with such officers. When this is done, a mutual understanding between the Commissioners of the states and the Commissioner of the United States will doubtless result in the enactment of uniform laws that shall protect the interest of the community without being onerous upon those who engage in the business of capturing fish for the market.

The sea fisheries of the country have been prosecuted on a very large scale, not the least important among which is that which relates to the capture and utilization of the Menhaden or Mossbunker. An immense capital is now invested in this business, employing several hundred sailing-vessels and quite a number of steamers, and having manufactories all along the coast for the conversion of the fish into oil and scrap. Many millions of gallons of oil were made in 1873, and the yield for 1874 will probably be much greater. A recent method of utilizing this fish consists in converting it into an article of food, which is sold in hermetically sealed cans, either as put up in oil or in pickle. A single establishment at Port Monmouth, New Jersey, consumes two hundred bushels daily in the summer, in the manufacture of what is technically known as "Ocean Trout."

Much apprehension has lately been aroused on the New England coast in view of the rapid decrease of the lobsters, both in number and size, resulting especially from the recent practice of canning; and the combined action of the Do-

minion and of Maine, New Hampshire, and Massachusetts has been invoked to regulate the traffic. The methods to be adopted will probably consist in the establishment of a period during which no lobsters shall be captured, and prohibiting the taking of female lobsters, or any males less than eleven inches in length, or weighing less than a pound or a pound and a half. Some idea may be gained of the magnitude of this interest by the statement, if correct, that 20,000 tons of lobsters were canned in 1873 in the British Provinces alone.

An elaborate article in the journal of the Scottish Meteorological Society gives the result of inquiries into the relationship between meteorological conditions and the sea fisheries, especially those of the herring; and enough is shown therein to indicate that this connection is closer than has been appreciated, and that in all probability a careful observation of ocean temperatures will enable those interested to understand and anticipate the now apparently capricious movements of the herring in their course to and from the shores.

In connection with the fisheries of the country, we may perhaps not inappropriately include the interests connected with the capture of the fur-seals of the Pribylov Islands in Alaska. As is well known, these islands have been leased to the Alaska Commercial Company, under certain conditions; at first with the restriction of the number of captures to 75,000 in the Island of St. Paul, and 25,000 in the Island of St. George. Quite lately this has been changed so as to allow the taking of 90,000 from the former and 10,000 from the latter. The fur-seals continue to furnish a highly fashionable article of clothing, and consequently are still in great demand. A considerable business is also done in the manufacture of oil, although the great quantity obtained from other sources has affected the price so greatly as to induce the Alaska Company to bestow comparatively little attention to that branch of its business.

The hair-seal fisheries of the Newfoundland seas were much less productive than in 1873; indeed, the Newfoundland government has become seriously alarmed at the sudden decrease, and proposes to institute an inquiry into the cause. Several of the European nations interested in the subject are,

it is said, contemplating the formation of a treaty to regulate the season, period, and amount of the hunt for these animals.

TECHNOLOGY.

In connection with the technology of the preceding division, we record the fact that an organized effort is about being made to utilize the waste or slack coal for fuel, upon the process devised by Mr. Loiseau, whose invention was referred to in our last yearly *Record.* The "Loiseau Pressed Fuel Company" has lately been formally organized, with a number of prominent coal operators in the management. The erection of the works is at present progressing at Port Richmond.

The annual meeting of the British Iron and Steel Institute afforded, among other matters of value to the metallurgist, an admirable opportunity for a full discussion of the experience gained in and the prospects of mechanical puddling.

The gist of this discussion indicated that thus far, upon the scale on which it has been introduced, machine-puddling has met with but questionable success; and American experience will probably coincide with this opinion. In the most influential quarters, however, the sentiment is strongly expressed that the ultimate triumph of the system in some form is certain. The difficulties of the process are various, and reside in the cost of the plant, which is considerable; and in the fact that rolls of exceptionally large size and great power are required to manipulate the large blooms produced in the rotary furnace, any accident to which would be a serious matter. But the most obstinate difficulty that is encountered is the rapid destruction of the lining of the furnace by the large masses of metal thrown into it.

To offset these disadvantages, its advocates advance the following points: It is possible to operate with much larger masses of metal, and to produce iron of far more uniform quality, than by the old method of puddling by hand, while the substitution of machinery relieves the laborer of the most exhausting manual work; involving the incidental advantage that the manufacturer is placed in a position of independence as regards skilled labor. The machine-puddling, again, it is claimed, can be performed more economically

than hand-puddling—a fact demonstrated by actual experience here and abroad; and the quality of the product is such as to command a higher price than that produced by hand from the same pig.

On the whole, it would appear that every where the mechanical system is gaining advocates, and it is fair to presume that most of the difficulties that now surround the problem will be obviated with a few years more of practice. The plan lately invented by Mr. Crampton appears, incidentally remarked, to be a decided improvement, and is now being largely introduced in England.

Mr. Crampton employs coal-dust fuel in his rotary furnace, and has introduced other novel features, chief among which is his method of constructing the water-casing, the chamber being lined with oxide of iron. The general results of Mr. Crampton's invention clearly demonstrate that, in the first place, slack or small coal can be utilized, and that coal-dust and air can be fed automatically—a matter that has sorely tried many who have endeavored to effect that object.

We may be able in our next *Annual Record* to announce material progress in this field.

The most interesting item connected with the metallurgy of *Iron*, originating on this side of the Atlantic, is the bringing out, at the spring meeting of the American Institute of Mining Engineers, of a new process for iron and steel making, by Thomas S. Blair, of Pittsburgh. The process in question produces malleable iron directly from the ore. Its essential feature consists in the production of an "iron sponge," which, according to the quality of product required, may be subsequently melted down in a bath of cast iron, the proportions being so chosen as to produce ingots of any desired degree of carburization. In the production of the metal from the ore, the temperature to which it is subjected is not raised so high as to melt the iron, and consequently the deoxidized iron retains the form of the ore introduced, but possesses a spongy texture, whence the name applied to it. This sponge presents so large a surface to the air, that if permitted to come in contact with it while hot, it readily oxidizes and returns to its original condition of sesquioxide. It is necessary therefore that it should cool before coming into contact with the air. The construction of a furnace in

which these conditions shall be realized is an important feature of Mr. Blair's invention. He obviates the difficulty, before named, by increasing the height of the furnace, and placing the zone of reduction so high up that, by the time the iron sponge has reached the bottom in its natural descent by gravity, it is already sufficiently cold to prevent oxidation. To impart and maintain the necessary temperature, it was found necessary to heat the ore in thin strata. This was accomplished by constructing the furnace in the form of a cylinder three feet in diameter, in the top of which was suspended an inner cylinder, twenty-eight inches in diameter, and about six feet long. The material is charged only in the annulus, heat being applied both inside and outside. The word "puddling," of course, finds no place in this process. The experiments thus far made with it seem to have been confined to rich ores from Iron Mountain and Lake Superior, and the product requires no subsequent purification. The assertion is made, likewise, that "titanium gives no trouble in the direct process," which, if sustained by experience, will greatly add to the value of the invention, since many rich beds of titaniferous ore must remain unworked in ordinary blast-furnace practice that can thus be utilized. Where the ores used are impure, the product will require purification, and this the inventor claims to be able to accomplish in a gas-furnace of peculiar construction. The economy of the process, which is after all the test of its value, is claimed to be considerable. The process is being operated on a large scale at Pittsburgh, though with what result we are unable to state.

The last year has witnessed also the invention and experimental trial of another direct process, which, although details are meagre, seems to have excited an unusual amount of attention. In reference to this novelty, *Iron* uses the following suggestive words: "It may have been thought by some that with the Bessemer-steel process we had seen the last startling innovation in the commercial manufacture of steel; but, according to the latest news from Vienne, we are, perhaps, on the threshold of another startling revolution."

The invention which has called forth the foregoing comments is a process which claims to effect nothing less than the "direct" production of steel from the ore—a problem

that has baffled the best metallurgical skill. The system is termed that of Ponsard (from the inventor), and resides in the direct treatment of the ores in a reverberatory gas-furnace of peculiar construction. Its essential features are a gazogene, which transforms the combustible into the gaseous state; a large chamber of many compartments, in which the operations are conducted; and an apparatus in brick called the "Recuperator," which absorbs the waste heat of the furnace, and gives it back in the form of hot air. The compartments of the working chamber serve successively for the reduction of the ore, for the reactions that are to be effected, and finally for the fusion of all the materials, so that a separation by virtue of difference of densities is made possible. These several operations require for their performance very different temperatures, and the Ponsard furnace, by its peculiar construction, meets the requirements of the case.

The first experimental run of steel upon the process here described was made on the 27th of September last, at the iron works of Les Verrières (Vienne), and is declared to have been quite successful; so much so as to warrant the announcement that steel may be produced direct from the ore, without passing through the roundabout and complex processes hitherto employed.

The fluorine process of purifying iron, invented by Mr. James Henderson, was introduced into this country during the past year at the works of the New Jersey Steel and Iron Company, Trenton; and the firm of Tuckerman, Mulligan, & Co., of the Ulster Iron Works, Saugerties, New York, are about to introduce it into their works. We have no space to enter into details, that are probably already well known to most of our technical readers through the journals, but may add that in the preliminary trials of the process at Trenton the most inferior cinder pig-iron that could be procured was used to test its value, and the result was a bar-iron of very superior quality. Again, ordinary anthracite pig-iron was made into the finest quality of wrought iron, which was equal to that from the best brands of Swedish iron. These trials remove any doubts that may have existed hitherto in the minds of the practical men who witnessed them, of the economical application of the process for the production of the higher grades of wrought iron.

Much importance attaches to the results obtained abroad by M. Euverte, in the direction of solving the problem of the manufacture of steel from cast irons containing phosphorus. At the last meeting of the *Société des Ingenieurs Civils*, the following points, in relation to the experimental work conducted under the direction of this gentleman at the Terre-Noire Works, were made public, and are of great interest to all concerned with the metallurgy of iron and steel. After inviting attention to the recent improvements in Bessemer practice, M. Euverte remarked upon the superior results obtained by the substitution of ferro-manganese for spiegel-eisen, in the production of steel from ores containing a high percentage of phosphorus. [The ferro-manganese referred to is an alloy of iron and manganese, manufactured by a patented process at the Terre-Noire Works, and contains as much, at times, as 69 per cent. of the latter metal.] The experimental pig-iron, in these trials, was first puddled with great care, and melted down in a Siemens-Martin furnace, and the ingots were rolled into rails. Although not entirely successful, these experiments indicated that, although it was not possible to eliminate the phosphorus by any rapid process like the Bessemer, it was quite possible, under certain well-defined conditions, to allow the phosphorus to remain in the steel without exercising any practically injurious effect upon its qualities; and it was proved that even with tolerably large amounts of phosphorus introduced into the steel in a Siemens-Martin furnace, the operation, when completed by the addition of ferro-manganese (containing 42 per cent. of metallic manganese), yielded a malleable steel of good merchantable qualities; and a repetition of similar experiments warranted the conclusion that "phosphorus may be introduced into cast steel, provided the carbon is eliminated, and the less carbon there remains, the more phosphorus may be left." If these experiments are substantiated in practice elsewhere, and are not found to be dependent upon locally favorable circumstances, we may soon have to record the extending familiarity on the part of iron manufacturers with the art of working irons and steels containing phosphorus, and the ultimate realization in the near future of the problem that has so long perplexed the metallurgist.

Of much interest in the same field is the statement made before the late meeting of the British Iron and Steel Institute, that the process of Jacobi for dephosphorizing iron ores previous to their being smelted in the furnace is in successful operation at the Adalbert Iron Works, at Kladno, in Bohemia. The process, incidentally remarked, consists in the treatment of the ores, in suitable apparatus (after roasting to drive off sulphur), with a solution of sulphurous acid, generated from the roasting of iron pyrites in contact with air. The residual liquid contains sufficient phosphate of lime, etc., dissolved from the ore, to pay for the cost of the process; and the sulphurous acid contained therein is driven out by boiling, and is led again into the towers and utilized repeatedly. The precipitated phosphate is sold for manure.

The new alloy, phosphor-bronze, referred to in our last yearly *Record*, has since then become domesticated in the United States. Smelting works have for some months been in operation in Pittsburgh, Pennsylvania, producing large quantities of the alloy, and supplying the Pittsburgh mills and some of our leading railroad companies.

The increasing demand for the phosphor-bronze is soon to be met, it is stated, by the establishment of additional works in Philadelphia or New York. If we may rely upon the announcement of Dr. Künzel, one of the discoverers of the alloy, he has lately developed certain new features in connection with it that possess much mechanical interest. Dr. Künzel states the discovery that when phosphor-bronze is combined with a fixed proportion of lead, the phosphorized triple alloy, when cast into a bar or bearing, segregates into two distinct alloys—one of which is a hard and tough phosphor-bronze, containing but little lead; and the other a much softer alloy, consisting chiefly of lead, with a small proportion of tin and traces of copper. The latter alloy is almost white, and when the casting is fractured will be found to be nearly equally diffused through it; the phosphor-bronze alloy forming, as it were, a species of metallic sponge, all of whose cavities are occupied by the soft metallic alloy segregated from it. The phenomenon of the segregation of combinations of copper with tin or zinc into two or more alloys has long been known, and from the fact that such separation is generally massive, and not equable throughout the mass,

is a source of great annoyance to the founder. Dr. Künzel claims, however, to have succeeded in causing this segregation to take place in uniform distribution throughout the casting, and has taken advantage of the properties of the product he obtains to construct therefrom bearings of railway and other machinery. In heavy bearings, such as those for marine engines, the valuable properties of Babbitt metal, and other anti-friction alloys, are well recognized; but these, being generally soft, soon become distorted under considerable pressure accompanied by continual vibration, and fail to sustain the journals in proper place. The machinist therefore resorts to the device of casting a hollow cage of hard metal of proper form for the intended bearing, the cavities of which he then fills up by casting into them the soft metal alloy, which thus forms the actual rubbing-surface of the bearing. The hard-metal cage thus supports the soft metal within, and prevents its distortion or escape, save by surface abrasion. The new phosphorized alloy of Dr. Künzel effects, it is claimed, the same result. It forms its own supporting cage for the soft bearing metal, which, as alluded to in the outset, separates from it in the process of cooling. He claims that these bearings combine the very small friction and non-abrasion of the journals with the firm resistance to pressure and stability of form of bearings of hard metals.

We can not omit to record likewise certain important and highly interesting discoveries concerning the behavior of metals under stress, which have attracted much attention during the past year, during which time they were fully developed. Professor Robert H. Thurston, in the course of some experiments with an apparatus for determining the tortional resistance of materials, which was provided with an automatic registry, permitted a test piece of wrought iron to remain in the machine strained far beyond its limit of elasticity, with the view of determining, if possible, the existence or non-existence of "viscosity" in the metals. The metal was left under strain twenty-four hours, and had not then yielded in the slightest degree: a fact that has an important bearing upon the availability of iron and of steel (which behaves similarly) for use in constructions exposed to severe strain.

After twenty-four hours, there appearing no evidence of further yielding, it was attempted to still further distort the

test piece, when the unexpected discovery was made that the resisting power of the specimen had actually become greater during the period of rest under strain, and the pencil of the register, instead of descending, rose until it indicated an increase of about twenty per cent. in the strength of the sample, when it traced a path parallel with, but above, that of the previous day. This remarkable observation was confirmed by repeated experiments. The phenomenon here discovered is the elevation of the limit of elasticity by a continued strain. Professor Thurston at once communicated his discovery to the American Society of Civil Engineers, in whose Transactions and the Journal of the Franklin Institute it appeared simultaneously shortly afterward. By one of those coincidences that are of such frequent occurrence in the annals of scientific discovery, where many independent observers are experimenting in the same field of investigation, Commander Beardslee, U. S. N., in experimenting upon the tensile strength of iron left under stress, made precisely the same discovery, without the knowledge that it had but a short time previously been published by Professor Thurston. The interesting feature of this independent observation, however, resides in the fact that it was made by a perfectly distinct method and apparatus. Professor Thurston's experiments were made with his "Autographic Testing Machine," and those of Commander Beardslee upon the ordinary form of Tensile Lever Machine. In the memorandum of Commander Beardslee containing his first publication on the subject, the test piece (bloom iron turned approximately to one-half square-inch section) exhibited a gain of resistance at a position of earliest set, *i. e.*, an elevation of the elastic limit, from 23,075 to 26,100 pounds per square inch, or 13.1 per cent. in seventeen hours. Continuing these experiments by direction of the Navy Department, Commander Beardslee made the further discovery that metal (iron) which had been submitted to strain until it had taken a set, and then removed entirely from the machine and laid aside for intervals of various lengths, when again replaced under strain increased in power of resistance as in the first instance.

The important fact therefore is established by these investigations that metal strained so far as to take on a permanent set gains in power of resistance within certain limits of time

and increase. In an elaborate discussion of the Mechanical Properties of Materials of Construction, Professor Thurston explains the elevation of the limit of elasticity by a continued strain, which the foregoing experiments demonstrate, in the following manner: "The cause is probably a gradual release of internal strain.... The manner in which this reduction of internal strain occurs, by continued stress at the limit of elasticity, as here observed, may be readily conceived. When the metal is thus strained, many sets of molecules are placed in positions in which they exert a maximum effect tending to produce molecular changes which may equalize the originally irregular distribution of inter-molecular stresses. After a time the change actually takes place by "flow," and the resisting power of the piece becomes increased, and its limit of elasticity raised, simply because its forces are now no longer divided, and may act together in resisting external forces." This explanation is eminently rational, and derives additional interest from Commander Beardslee's experimental confirmation of the fact, deducible therefrom, that this release of internal strain occurs to a nearly equal extent if the strained piece is simply laid aside for a similar interval after it has been given a set.

The interest and importance attaching to the discovery of the principles above enunciated to the engineering profession, and to science in general, can not be overestimated.

It is of incidental interest to note also that, at the suggestion of Professor Thurston, the trustees of the Stevens Institute of Technology have authorized the establishment in connection with that institution, of a laboratory devoted to technical research, designed especially to meet the necessities of the industrial interests of the country. The laboratory, it is decided, will be devoted exclusively to the conduct of researches of a practical bearing upon the arts and manufactures—such, for example, as the determination of the strength and other physical characteristics of materials of construction, the value of fuels, of lubricants, etc.

Especially worthy of record in our summary of technical progress for the year are the highly interesting experiments that have recently been made in the Assay Department of the United States Mint at Philadelphia, by Mr. Alexander E. Outerbridge, to ascertain the practicability of assaying metals

used in coinage by means of the spectroscope. These experiments were made with the object of estimating the practical value of a recent discovery of Mr. Lockyer, and upon which he founded a theory of possible *quantitative* spectrum analysis. Briefly stated, Mr. Lockyer's discovery consists in the observation that when a powerful induction-coil is employed, and the distance between the metallic electrodes is gradually separated, certain of the lines in the spectrum of the metal (or metals) under observation break in the middle; and that upon increasing the distance of the electrodes, the hiatuses in the spectral lines increase proportionately, but unequally, with different alloys. The experiments of Mr. Outerbridge, which were quite thorough, seem to establish, at least in the present state of spectroscopic knowledge, the apparent paradox that the spectroscopic method is in one respect far too sensitive and minute, and in another far from being minute enough, to serve the uses of assay. The problem simply stated is this — to discern differences in the lines of the spectra of different alloys of gold and silver; in other words, to utilize the spectroscope as a means of *quantitative* as well as *qualitative* analysis. We can not detail the construction of the apparatus nor the conduct of the tests made therewith, but will simply state the difficulties encountered and the conclusions drawn. The author found, in the first place, that the method was not sufficiently delicate to afford visible differences in two alloys which could readily be estimated by the usual method. Variations in the length and brightness of the lines, and the confusion of the eye resulting from long-continued comparison of minute differences, were likewise found to be incidental to the process. Again, the quantity of metal vaporized by a spark and giving the spectrum was found to be too infinitesimal (not more than the $\frac{1}{1,000,000}$ of a grain) to give safe results for a large melt, since the appearance of the lines would be affected by the least want of homogeneity in the metal. Another difficulty was found to reside in the fact that, while the spectroscope is very sensitive to pure metals, a comparatively large quantity of gold may be present in an *alloy*, and the spectroscope not indicate its presence, and the same difficulty holds good for alloys of other metals.

From the foregoing, the author draws the following conclusions: "It is not impossible that future discovery may succeed in explaining this anomaly, in harmonizing apparent inconsistencies, in eliminating the sources of error, and in reducing the operation to practical certainty; but in the state of spectroscopic science as it now exists, so far as I have been able to perceive, I have arrived at the opinion, not without regret, that assaying by means of the spectrum analysis is impracticable for the purpose of Mint operations.

In connection with the important subject of the artificial preservation of timber, the process of M. Hatzfeld, lately described in a paper before the French Academy, is worthy of comment. The author in question proposes to inject into the wood, by the Boucherie process (the hydrostatic pressure of a heavy liquid column), or some similar plan, a solution of the acid tannate of iron. The principle upon which the merit of the plan is based is stated by the author to be that the action of tannin upon vegetable tissues is analogous to that which it exercises upon the animal tissues, effecting in the former a kind of tanning, which will have for result the formation of hard and imputrescible tannates, quite analogous to the gelatinous tannates produced in the tanning of skins. By this application, therefore, he proposes to fix the putrescible matters in the wood, to the presence of which its rotting is very properly attributed, in unalterable combinations, thus preventing their decomposition. The French government and several of the French railroad companies are testing the merits of the process.

In the field of illumination and heating nothing of special importance has transpired during the year to warrant mention, save perhaps some successful experiments in London with the electric light of MM. Ladyguin and Kosloff. The features of this plan consist in having the carbons placed in a closed glass vessel filled with a gas not containing oxygen, the sticks being held in place by metal connections of peculiar construction. The lamps experimented upon were nine in number; six having two carbon-rods each, and the other three one each. The glowing of the carbons takes place throughout their entire mass. The experiments demonstrated satisfactorily the fact that the electric current could be subdivided to operate a number of lights simulta-

neously. The apparatus used for producing the current was the Gramme machine. It may also be remarked in this branch of our Summary that the use of natural gas for fuel in various quarters has been considerably extended, the last year having witnessed its introduction for industrial uses in a number of places.

While no novel or revolutionizing inventions have appeared during the past year in the field of illumination, our technical record would be incomplete without mentioning the substantial progress achieved by the advocates of the water gas and petroleum gas. The late meeting of the "American Gas-light Association"—a body representing a large share of the talent employed in this country in gas manufacture—was occupied almost exclusively with the discussion of the processes just named. The chief interest, however, was centred upon the performance of the most recent of these innovations—the so-called Gwynne-Harris process. Briefly described, the essential features of these patents is the employment of clay retorts (instead of iron) in which the decomposition of superheated steam is effected. The superheating is done by the employment of superheaters of clay set in the hottest portions of the bench—the object of which disposition is to secure the perfect conversion of every particle of watery vapor into superheated steam before it enters the decomposing retort. The decomposition is effected by passing the superheated steam into a heated retort supplied with anthracite coal; the introduction taking place through a cellular bottom formed of perforated tiles. The steam is thus made to flow in a regulated manner from below upward, by numerous small openings, through the highly heated anthracite; and the decomposition of the same into hydrogen and carbonic oxide, effected with such regularity as to afford practically uniform results. The mixed gases resulting from this decomposition are then passed through retorts charged as usual with bituminous coal, so as to secure the uniform admixture of the water-gas with the products of the bituminous-coal distillation, and producing an illuminating gas of uniform composition and permanent character. The difficulty of perfectly decomposing the water into the two gases above named, which appears to have been an insuperable obstacle to the success of previous inventions of

this nature, appears, according to the analytical results obtained by Professors Silliman and Wurtz, to have been practically overcome by the Gwynne-Harris mechanism.

The latest and most interesting development of this process is that of employing its water-gas features with oil or naphtha gas. As carried out at one of the Brooklyn works, a coal gas of low illuminating power is made, the retorts being run so as to secure the highest possible yield. The gas thus obtained, or a portion thereof, is then mixed with the water gas (obtained as above), carried to the naphtha works, and forced through the stills. Having loaded itself with the enriching vapors of the naphtha, it is passed through other heated retorts, when, it is claimed, an illuminating gas is formed possessing a permanency superior even to that possessed by coal gas. Its subsequent treatment is simply that now used in the condensation, etc., of ordinary coal gas. In quality the petroleum water-gas is said to be decidedly better than the average of that from coal, and the cost of its manufacture is placed at one third less than the latter. There are said to be some twenty or more works in this country now making oil gas.

The utilization of the light petroleum oils in this manner must be looked upon with favor in every quarter; and it is to be desired that the demand for them in this opening field will grow to such an extent as to effect their complete withdrawal from those illegitimate and reprehensible uses in which their dangerous qualities are so prominently involved, to the constant peril of life and property.

A vulcanized-rubber iron tube, we may remark, is a novelty recently introduced as an article of commerce by Messrs. Morris, Tasker, & Co., which is claimed to possess superiority over all other materials as a conduit for water, hot or cold. It is said to withstand a high temperature without injury, and to resist the corrosive action of sulphuric and muriatic acids and of caustic alkalies.

The gradually extending introduction into the larger towns and cities of our country of the pneumatic system of excavating vaults, cesspools, etc., to replace the barbarous and unwholesome method of removing such accumulations of refuse piecemeal with buckets, may be looked upon as indicating a growing appreciation of a most valuable

sanitary regulation. During the past year the system alluded to was adopted either exclusively or in part in quite a number of localities.

Many matters of importance in this department have doubtless been overlooked, or perforce omitted, because of the limited space at our command. We may hope, however, notwithstanding the comprehensiveness of the field, to have selected at least the salient points of interest out of the host of items and novelties which make up the progress of the year in the application of science to the useful arts.

COMMERCE.—TRADE.—INDUSTRIAL STATISTICS.

The preparation of the *Annual Record* in advance of the actual close of the year involves the loss of certain interesting statistical figures concerning the condition of home and foreign trade, internal improvements, and manufacturing industries; or the substitution of estimated for ascertained values. The effects of the great financial crisis, which are manifested on all sides in the almost universal depression of business, and the suspension of work upon our great public improvements, will make the year 1874 a memorable one in the annals of the country. The following statistics of our foreign trade, from the report of the Bureau of Statistics for the fiscal year ending June 30th, 1874, reaching back as they do into a period of comparative business activity, display certain gratifying features in the item of domestic exports, which will quite certainly be unfavorably modified during the current year. The appended table shows the gold value of imports, exports, and re-exports for a series of years:

TOTAL IMPORTS, ETC.

	Imports.	Exports.	Re-Exports.
1868–69.........	$437,314,255	$318,088,624	$25,173,414
1869–70.........	462,356,163	420,518,951	30,427,124
1870–71.........	541,493,708	513,044,273	28,459,899
1871–72.........	640,348,766	501,285,371	22,769,749
1872–73.........	663,617,147	578,938,985	28,149,511
1873–74.........	595,861,248	629,252,156	23,780,338

The effect of the panic in diminishing the demand for foreign goods will be manifest from an inspection of the above. The following table gives the value of the importations for

three years of the five leading classes of manufactured goods that compete with American manufacturers:

	1871-72.	1872-73.	1873-74.
Iron and Steel.......	$55,540,188	$59,308,388	$33,713,455
Cotton Goods........	33,307,447	35,201,317	28,183,878
Woolen Goods.......	52,408,471	51,075,462	46,882,901
Silk Goods..........	36,448,618	29,989,869	23,997,301
Linen Goods........	21,220,496	20,428,315	17,473,765
Total............	$198,925,220	$196,003,351	$150,251,300

During the fiscal year 1873–74 the increase in our exports has amounted to $54,500,000 (currency), our specie export has decreased by $14,200,000, a gain of $62,600,000 to our credit in our account with foreign nations.

The *Iron* producing and manufacturing industries are in a condition of even greater prostration than represented in our last year's review. This condition of things is in keeping with the general depression of manufacturing interests throughout the country, and its causes are too patent to require consideration here. The impossibility of securing accurate returns of yearly production until some time after the close of the year applies of course to every department of industry; the difficulty of getting reliable information, however, appears to be intensified in this particular department. Our estimated returns for 1873, as given in our last year's *Record*, will now need a slight modification in the light of facts collected during the current year. From the complete returns from all the states, as given in the *Bulletin* of the American Iron and Steel Association, the home production of pig-iron for 1873 is placed at 2,868,278 net tons (of 2000 lbs.); the estimated figures given on the same authority in our last year's *Record* were 2,695,434 net tons, a very close approximation to the truth. The following is a summary of the leading facts bearing upon the present state of this important industry, issued by the Association, July 23d of the current year. All tons are net tons of 2000 lbs.:

Whole number of stacks, December 31st, 1871..................	571
Whole number of stacks built in 1872...........................	41
Whole number of stacks, December 31st, 1872..................	612
Whole number of stacks built in 1873...........................	50
Whole number of stacks, December 31st, 1873..................	662
Whole number of stacks in blast, January 1st, 1874.............	410

Whole number of stacks out of blast, January 1st, 1874	252
Whole number of stacks completed in the first 6 months of 1874	11
Whole number of finished stacks, July 1st, 1874	673
Whole number of stacks building, July 1st, 1874	53
Whole number of stacks projected, July 1st, 1874	61
Total production in 1872, in tons	2,854,558
Total production in 1873, in tons	2,868,278
Estimated annual capacity of all finished stacks—tons	4,500,000
Number of states having furnaces	25
Number of states making pig-iron in 1872	21
Number of states making pig-iron in 1873	22

The Secretary of the Association estimates the pig-iron production for 1874 at 1,912,185 tons; showing a falling off from the ascertained production for 1873 of 956,093 tons, or about 33 per cent.

The decrease in the American make of rails in 1873, owing to the sudden restriction of railroad extension during the last quarter, is given in our last *Record* at nearly 100,000 tons. During the present year this enforced economy on the part of the roads has amounted to a very general suspension of building operations—a fact which has reacted with telling effect upon the rail-maker, involving a decrease of production as compared with the figures of 1873 of nearly 450,000 tons, or about 50 per cent., as the following data, appended for comparison, will indicate:

	Tons.
Rails, 1872, including Bessemer, ascertained	941,992
Rails, 1873, " " ascertained	884,667
Rails, 1874, " " estimated	442,337
Bessemer rails for 1872, ascertained	94,070
Bessemer rails for 1873, ascertained	129,015
Bessemer rails for 1874, estimated	75,000
Other rolled iron, 1872, bar, sheet, plate, etc., estimated	1,000,000
Other rolled iron, 1873, " " estimated	980,000
Other rolled iron, 1874, " " estimated	490,000
Cast steel for 1872, ascertained	40,000
Cast steel for 1873, ascertained	44,000
Cast steel for 1874, estimated	45,000

[For the estimated values in the above we are indebted to the courtesy of the Secretary of the American Iron and Steel Association, Mr. James M. Swank.]

The record of railroad construction for the year 1874 gives the key-note of the continued depression of the iron industries. As far as ascertained, there have been 1923 miles of

new railroad completed in the United States in 1874; against 3883 reported for the year 1873, and 7340 in 1872. It is probable, however, that when all the returns are in the figures for 1874 will slightly exceed 2000 miles; showing a decrease of about 50 per cent. on the figures of 1873, and nearly 75 per cent. on those of 1872.

The total aggregate of the railways in Europe and the United States, according to the latest reliable statistics, is herewith appended as a point of incidental interest: Germany, 12,207 miles; Austria, 5865; France, 10,333; Russia, 7044; Great Britain, 15,814; Belgium, 1301; Netherlands, 886; Switzerland, 820; Italy, 3667; Spain, 3401; Denmark, 420; Portugal, 453; Sweden and Norway, 1049; Greece, 100.

	Miles.	Population.
Railroads in Europe	63,360	282,456,742
Railroads in the United States	70,650	40,232,000

The railway rolling stock, as given in Poor's *Manual* for 1874–75, on the roads of the United States and Canada, foots up as follows:

Passenger cars of all classes	2,990
Baggage, mail, and express cars	4,157
Box, merchandise, and house cars	87,009
Platform, gondola, and flat cars	52,198
Stock cars	14,222
Coal cars (number of wheels not stated)	66,887
Four-wheel cars (mostly coal)	37,892
Caboose cars	1,549
Oil cars	3,154
Ore cars	2,102
Lumber cars	193
Freight cars (not classified)	94,694
Total	367,047
Locomotive engines	41,939

Deducting from these aggregates 774 engines and 13,980 cars of all classes, as returned by the Canadian roads, leaves for the roads in the United States a total of 14,165 engines and 359,979 cars.

The most noteworthy undertaking in railroad construction carried on during the past year is the pushing forward of the great South American railroad connecting the Pacific Ocean with the Valley of the Amazon; and which when completed will prove to be another of the marvels of en-

gineering skill of which this century has been so fruitful. At the last accounts a force of from 8000 to 12,000 laborers was employed upon it day and night.

During the past year two new transatlantic cables have been projected and partly laid. It has likewise witnessed the completion and opening for business of the great ocean cable between Lisbon, *via* the Azores, and Rio Janeiro.

The preparations for the Centennial during the year have assumed a very forward state. The erection of the buildings is rapidly progressing, and despite much adverse criticism which the project at first originated, there appears to be now no doubt of its complete success. Nearly all of the leading nations of Europe and Asia have signified through their representatives their intention to participate, and of the interest of American manufacturers there is indubitable evidence. The applications of intending American exhibitors already call for appropriations of space somewhat in excess of that set aside by the Commissioners for American exhibits in the main Exhibition building.

The following is the official statement of the space to be allotted to the thirty-four nations and their colonies that will take part in the Exhibition, together with the order of their arrangement. The total area of the building will be twenty-five acres:

Nation.	Sq. Feet.	Nation.	Sq. Feet.
Siam	3,946	Reserved space	21,408
Persia	7,776	Mexico	11,664
Egypt	7,776	Honduras	3,888
Turkey	7,776	Guatemala	5,508
Russia	10,044	San Salvador	4,536
Sweden and Norway	10,044	Nicaragua	4,536
Austria	23,328	Venezuela	5,508
German Empire	27,264	Ecuador	3,888
Netherlands and Denmark	7,776	United States of Colombia	7,776
Switzerland	6,156	Peru	11,664
Italy	11,664	Chili	9,744
Spain and Colonies	15,552	Brazil	17,520
France, Algeria, and other Colonies	27,264	Argentine Republic	15,552
		Hayti	3,888
Great Britain, Canada, India, Australia, and other Colonies	46,748	Sandwich Islands	3,888
		Liberia	2,268
		Japan	7,290
United States	123,160	China	7,290
Total			484,090

The space above allotted is something over eleven acres.

The several conventions of the American branch of the International Patent Congress during the past year are worthy of notice, as having an important bearing upon a much-needed reform—namely, the unification of the now discordant patent systems of the world. An International Patent Congress, to be held in Philadelphia during the time of the Centennial Exhibition, is in contemplation.

The annual report of the late Commissioner of Patents—General M. D. Leggett—was recently submitted to the Secretary of the Interior. We append herewith an abstract of so much thereof as we deem of interest:

The total receipts of the Office from all sources during the year from October, 1873, to September 30th, 1874, were	$721,110
Total payments	694,072
Excess of receipts over expenditures	$27,038

The following is a tabulated and classified statement of the business of the Office during the same period:

Number of applications for patents from October 1st, 1873, to September 30th, 1874	21,077
Number of patents issued, including reissues and designs	13,545
Applications for extension of patents	229
Patents extended	308
Caveats filed	3,129
Patents expired	5,287
Patents allowed, but not issued for want of final fee	2,680
Applications for registration of trade-marks	589
Trade-marks registered	524
Applications for registration of labels	107
Labels registered (since 1874)	50

It will appear from comparison that the number of applications and of patents granted is a slight increase upon those of the preceding twelve months. Commenting further upon the report, the Commissioner remarks that the prompt publication of abstracts of patents issued has materially improved the character of such applications, the consequence being the rejection of a much smaller proportion of applications. Before the publication of the weekly Patent-Office *Gazette*, it was from two and a half to three years after the issue of a patent before the public were made officially aware of its existence. In consequence thereof there were constantly in existence some twenty or thirty thousand patented inventions unknown to the public at large, and the Office

was constantly receiving applications for devices already secured by letters patent.

The great importance of a thorough digest, published in convenient form, of each one of the one hundred and forty-five classes of inventions—for the convenience of examiners, inventors, and attorneys—is strongly urged. The need of additional room is also dwelt upon.

ENGINEERING AND MECHANICS.

In this department there are many items of interest to record concerning the progress of the year just passed. The great steel bridge across the Mississippi River at St. Louis, together with the tunnel forming part of its western approaches, is finished, and was formally opened for railway traffic with much ceremony on July 4th. The strength of the structure was shortly thereafter tested by moving out abreast and simultaneously over each one of the three spans two trains of seven locomotives each. The results of the test agreed very closely with the theoretical computation, and the trial proved highly satisfactory. The work upon the great suspension bridge to span the East River between New York and Brooklyn has progressed but slowly, owing to complications of a legal and financial character. The Brooklyn tower was completed on the 16th of December, 1874. The anchorage on the Brooklyn side is also in a forward state. When completed, this will be the largest suspension bridge in the world, the clear span between the towers being 1600 feet.

The railway tunnel through the Musconetcong Mountain in Northern New Jersey, an engineering work of considerable magnitude, was practically finished by the union of the two headings on the 16th of December. The tunnel proper is over a mile in length, with long open cuts at each end. The road of which the tunnel is part is an extension of the Lehigh Valley Railroad, and the tunneling has been progressing for more than two years.

The system of underground railways, so long in successful operation in a number of European capitals, and affording the only rational solution of the problem of railway transit through populous cities, is about to receive an important extension in this country. In our last yearly *Record* we commented upon the completion of the Baltimore underground

railways, as the first successful realization of the features of this system that had been effected here. During the year 1874 the system has been extended to St. Louis, and is about to be fully inaugurated in New York.

The objective point of the underground railway system of the last-named city is the Grand Central Dépôt, located at the junction of Forty-second Street and Fourth Avenue, the railway centre of the city. When completed, it will run from the Harlem River, on the north, through the heart of the city, under Fourth Avenue and Broadway, to the Battery, a distance of $8\frac{3}{4}$ miles. The existing northerly section of underground railway extends northward from the dépôt, under the surface of Fourth Avenue, to the Harlem River, where the track rises and crosses a bridge. This portion is now in course of completion, and was expected to be ready for traffic in January, 1875. The southerly section of the work, the so-called Broadway Underground Railway, to extend from the Grand Central Dépôt to the Battery, was authorized by the Legislature of the state in May, 1874, and will be completed as soon as financial preliminaries can be arranged.

Of other works in progress or projected during the year, it may be of interest to note a proposition to bridge the Mississippi at Quincy, Illinois; and another, to bridge the same river at Carondelet, which seems, however, to have awakened considerable opposition. Another international bridge across the Niagara River, at Grand Island, is likewise projected, and charters from the proper authorities were obtained.

The Hoosac Tunnel, which it was generally expected would be opened for traffic about July or August, will in all probability not be ready for use until the spring of 1875. A new tunnel through Bergen Hill, commenced during the early part of the last year by the Delaware, Lackawanna, and Western Railroad, is progressing gradually toward completion. A new railroad tunnel under the Hudson River, to connect New York and Jersey City, has likewise been commenced. The tunnel is projected from the foot of Fifteenth Street, Jersey City, and will extend beneath the river to near the foot of Canal Street, New York, from which point connection will be made with the underground railway system at present in course of completion in the latter city.

The Fort Philip Canal, an enterprise projected during the last year, is a scheme providing for a canal two hundred feet wide at bottom, and twenty-five feet deep, to form a permanent highway from the Mississippi to the Gulf of Mexico. The work, it is proposed, shall be constructed by the United States, and when completed shall be free to all nations. The proposed canal is to extend a distance of six and a half miles from the left bank of the river below Fort St. Philip, to a point four miles south of Breton Island. Its advocates claim that the construction of such a canal would effect the desideratum of keeping the channel of the great river constantly open. A plan for the same purpose, originated by Captain Eads, was rejected by the last Congress. It proposed the building of jetties upon each side of the stream, and thus, by narrowing the channel, create a swifter current, which would deepen itself by scouring, and effect the removal of its sediment farther out to sea.

Another project of like character was lately brought before the Legislature of New York, namely, the construction of a navigable water-way between Troy and Lake Champlain. The plan includes the deepening of the Hudson River from Troy to Fort Edward, and the excavation of a canal from the latter point to Whitehall, on the lake. Its object is to increase the facilities of New York to command the commerce of the West.

A project of similar intent, the James River and Kanawha Canal, to connect the James and Ohio Rivers, claiming to possess extraordinary advantages as a measure of relief to the West, in producing a great highway for the cheap transportation of its bulky productions to market, and for fostering commerce in general, has been made, during the past year, the subject of a favorable report by General A. A. Humphreys, United States Army. Since the abandonment of the Cheeseborough Tunnel beneath the Detroit River in 1873, a number of tunnel and bridge projects have been mooted, but thus far to no purpose. In this connection, we may add that during the past year a commission, appointed by the Secretary of War to inquire into the practicability of bridging the river, reported in favor of a tunnel as the only unobjectionable mode of meeting the necessities of the case.

Abroad, the interest of the engineering world is centred upon a number of important projects; the most interesting of which perhaps is the Channel Tunnel, to connect England and France. During the past year this stupendous undertaking was the theme of extended discussions before the several engineering societies, and the preliminary steps toward its execution are being steadily advanced. The geological and mechanical questions appear to have been answered favorably to the undertaking, but it is questionable whether the enormous expense which it involves will not prove an insurmountable obstacle in the way of its execution. A new tunnel under the Thames, to facilitate communication between certain quarters of the English metropolis, is projected, and likewise a scheme for tunneling the Mersey (an old project revived), so as to connect all the docks, railways, and canals on both sides of the river. The so-called Severn Tunnel project, an undertaking which is to connect South Wales with the West of England by a continuous line of railway, assumed a somewhat practical form during the past year. The directors of the Great Western Railroad, having satisfied themselves of the practicability of the work by preliminary borings, have advertised for tenders for the completion of the first seven hundred and fifty yards.

Upon the St. Gothard Tunnel, which is to be the German rival of the Mont Cenis, work has been vigorously prosecuted during the past year. At the close of the year about 2500 meters (or somewhat over 2700 yards) had been completed. Another important project advanced during the year contemplates the passage of Mont St. Bernard. A series of seven tunnels is proposed, the longest of which is to be 5800 meters in length. A proposition made to the French Assembly to effect a loan of forty-eight millions of francs for the construction of a tunnel under the Simplon Pass was by it referred to a commission of engineers, which, upon full consideration of the scheme, reported adversely. The proposed route would possess important advantages in shortening the distance between Paris and Plaisance (Italy), and also with respect to altitude, but involves the necessity of traversing the Jura Mountains, where heavy grades would be necessary; while, in addition, it was believed that the proposed line could not compete favorably in the important mat-

ter of cheap transportation with that of St. Gothard, now in course of construction.

The past year has likewise given origin to several projects of vast possible importance to the far East. One of these—the Indo-European Railway—as its name implies, contemplates the union of the South and West of Europe with the richest portions of Central Asia, and further on in the future with the far eastern parts of that continent. Several plans with this object in view are, it is stated, receiving the consideration of the governments most interested. A second enterprise of much interest to the engineer is the proposition to create a great inland sea, or chain of lakes, on the plains of Northern Africa, in the Desert of Sahara. The topographical features of the country are said to be favorable to the project; and the information comes to us that General Chanzy, the Governor of Algeria, has ordered preliminary surveys to be made to determine the question. Many speculations are indulged in upon the possible influence of such a work on the climate, productions, and commerce of the neighboring countries.

In the operation and management of railroads, no feature of special novelty presents itself in our yearly retrospect. The disposition on the part of companies to look with favor upon plans for adding to the security and control of trains is manifest in the extending introduction of the several standard power-brakes and safety-switches. During the past year the hydraulic system of train-brakes, for which many advantages in point of simplicity are claimed by its advocates, has attracted considerable attention, and its effectiveness has been satisfactorily demonstrated in several interesting trials of the Henderson hydraulic brake, the best representative of its class in this country so far introduced. The various signaling systems employed by the roads throughout the country have received a searching criticism in several quarters. Impressed with the importance of the unification of the diverse and arbitrary plans in use, and of the necessity of doing away with the many dangers and inconveniences attendant upon the present condition of things, the American Society of Civil Engineers has attempted the task of collecting information on the subject, with the view of securing a much-needed reform in this particular. The

result of this inquiry will doubtless be a recommendation for the universal adoption by the roads in this country of some form of the electrical block signal system, now largely adopted in Europe, and upon some American roads, with the most satisfactory results.

The Pullman parlor and palace cars, so popular in this country, have met with a very favorable reception abroad, and during the past year have been introduced as an adjunct to many of the European roads.

The commercial depression has exerted its influence upon the ship-building interests of the country as upon others. In spite of the unfortunate business outlook, however, the iron ship builders upon the Delaware have had a busy season. Some of the iron steamers launched during the year, the Pacific Mail Steamship Company's vessels the *City of Peking* and *City of Tokio*, were of the largest size (second only to the *Great Eastern*), and of most approved construction. Both of these vessels are provided with engines of great power, and will be, if we may judge from their performances upon their trial trips, unequaled for speed by any ocean steamship afloat. Three additional vessels of similar size and pattern are now in course of building at Chester for the same company. The steel torpedo-boat *Aerolite*, built for the government by Neaffie & Levy, of Philadelphia, is a novelty worthy of record, and made on her trial trip a few months ago the remarkable speed of twenty-one knots an hour. The aggregate tonnage of the thirty or more iron steamships that have been built upon the Delaware within the past two years will exceed sixty-eight thousand tons. It is of interest to record here the conditional sale of the famous Stevens Battery to the United States government, which was effected in the month of November.

Of incidental interest likewise is the completion at Hull, during the past year, of the swinging saloon steamer designed by Bessemer for the Channel passenger traffic, and intended to avert the discomforts of sea-sickness by maintaining the constant horizontality of the saloon with the aid of hydraulic machinery. The *Castalia*—a double vessel intended for the same traffic—was launched about the same time. Thus far, however, the efficiency of neither vessel has received a test.

The past year has likewise witnessed the invention of a considerable improvement in telegraphy. The remarkable duplex apparatus of Stearns, with the aid of which messages are sent both ways on one wire and at the same time, has been vastly improved upon by Messrs. Thomas A. Edinson and George B. Prescott, who have discovered processes and invented apparatus by means of which two messages can be sent in the same direction, and two others in the opposite direction, simultaneously upon the same wire. This invention has been named the Quadruplex, and is in successful operation between the New York and Boston offices of the Western Union Telegraph Company, and is stated in its annual report, just issued, to be satisfactorily performing an amount of work upon one wire quite equal to the capacity of four wires worked with the ordinary Morse apparatus. One of the greatest recommendations of the invention resides in the fact that it calls for no changes in existing apparatus; the old Morse Key is used without the need of specially educated operators, and with no duplication, save as to parts of machinery.

The first named of these gentlemen has, however, quite lately announced another discovery of unusual interest and importance in connection with what is known as the automatic or chemical telegraph, in which the signals are made and recorded by causing the current to pass through paper, the latter being saturated with a chemical substance, which changes in color when the current acts. Mr. Edinson calls his discovery the Electro-motograph, and has founded upon it a practically new system of telegraphy. In the chemical telegraph the markings are made on the chemically prepared paper by passing currents of electricity through a stylus resting on the paper, which passes over a metal drum. Mr. Edinson noticed that with certain compositions motion was produced in the lever holding the stylus, which was caused apparently by the sudden diminution of the friction of the paper.

It was found that paper prepared with caustic potash and a stylus tipped with tin gave the best results.

The following account of an experimental trial will best serve to indicate the nature of the phenomenon. The stylus of the Electro-motograph in question was of tin, but held in

a peculiar form of clip, which brought a great amount of friction on the paper, so much so that when the instrument was started the great friction carried the stylus forward. So soon, however, as a current was passed through it, decomposing the paper, all friction appeared to cease, the clip was drawn back, and the pencil slid upon the paper with the utmost ease, and this occurred each time the current passed. Immediately, however, the current ceased, the friction of the paper was restored, and the stylus was drawn forward.

It appears to be a matter of indifference as to the character of the metal used for the drum, which acts as one of the decomposing electrodes. Of all the solutions tested, potassic hydrate was found to give the best results. Lead, thallium, and tin, in the order named, are recommended for the stylus.

The following comments upon the applicability of this discovery of Mr. Edinson, condensed from one of our best scientific journals, will best serve to illustrate its importance:

The salient feature in Mr. Edinson's present discovery is the production of motion and of sound by the stylus, without the intervention of a magnet and armature. By the motion thus produced he operates any of the ordinary forms of telegraphic printing or sounding instruments or relays, and is enabled to send messages by direct transmission over thousands of miles of wire at the highest speed, without rewriting or delay of any kind. More than this, his apparatus operates in a highly effective manner under the weakest electric currents, and he is enabled to receive and transmit messages by currents so weak that the ordinary magnetic instruments fail to operate, or even give an indication of the passage of a current. Thus, when the common instruments stand still, owing to the weakness of the current, the Edinson telegraph will work up to its fullest capacity.

The discovery upon which this new system of telegraphy is based has attracted much attention both here and abroad; and involving, as it does, a new discovery in science, may undoubtedly be called the most interesting and valuable contribution to telegraphic progress that has lately been made.

During the last year, also, the employment of steam on our canals became an accomplished fact. From last accounts some six boats of the Baxter pattern were plying on the Erie Canal, and a number of others are shortly to be added, capable of making the trip from New York to Buffalo in five days. In this connection, we may mention the novel proposition of Mr. Robert Cheesebrough to keep the canals open in winter by warming the water with the aid of steam ice-melters and breakers. Although the proposition was favorably commented upon in many quarters, it has not yet been practically put in operation.

Of mechanical interest are the remarkable results attained by Messrs. Hoopes & Townsend, of Philadelphia, during the past year, in punching cold iron. A number of samples exhibited at a meeting of a noted scientific body attracted much comment from the fact that one of them had a hole one quarter of an inch in diameter and one inch deep, and others were perforated with a hole half an inch in diameter and one and a half inches deep. The remarkable nature of the results here exhibited (and which it is understood are regularly obtained on the practical scale) will appear when compared with the generally received rule of the workshop that "the maximum thickness of iron that can be punched cold is about the diameter of the punch." The depth of the smaller nut referred to is four diameters of the punch, and that of the larger ones three diameters.

We have no figures at hand whereby to ascertain the production of coal for the past year; but from the very general depression of manufacturing industries that has prevailed, it is highly probable that it will fall considerably below that of 1873 and several preceding years.

In connection with our annual review of this subject, several items of interest call for mention.

In the Wyoming coal region, near Wilkesbarre, Pennsylvania, extensive and destructive mine fires by some means broke out, and for many months defied every effort to subdue them. Within a short time, however, the persistent use of steam is said to have brought the fires under control.

An apparatus termed the "Aërophore," and which is said to be so much of an improvement upon former attempts in

constructing life-saving apparatus that it enables a workman to enter a mine filled with fire-damp, and to labor there for hours at a time with practical immunity from danger, attracted within the year a large share of attention in the Continental and especially in the English mining districts, where occasion for employing such devices is of frequent recurrence. The chief merit of the "Aërophore" appears to reside in the fact that its operation is continuous. We have only space to state concerning it that it consists of an air-pump of novel construction, a regulator, a strainer, an air-tube wound on a self-regulating coil, and a lamp.

The following table shows the production of all kinds of coal in the United States since 1864:

Year.	Tons.	Year.	Tons.
1864	22,500,000	1869	33,761,010
1865	24,400,000	1870	36,622,131
1866	28,855,918	1871	37,861,417
1867	28,361,847	1872	42,749,246
1868	31,479,114	1873	44,843,962

The production of 1873 is composed of — anthracite, 22,828,178 tons; bituminous, 22,015,784 tons; being very nearly equally divided.

In this country, the last year witnessed no extension of the introduction of coal-cutting machinery. In England, however, the interest in this important subject is unabated, and the adoption of the machine for hand-labor is making decided advances, as might be anticipated from the fact that the comparative thinness of the coal-seams of that country afford the best conditions for their economical employment.

The so-called Gartsherrie machine appears to be the favorite, and we record below some considerations concerning it expressed by the advocates of the system, who claim with much justice for machine work: 1, a diminished cost of production; 2, an improved ventilation; 3, a reduction of waste; and, 4, a relief to the miner from the severest portion of his toil. The following tabulation, based on the result of a year's working, gives the cost and the number of men required to remove one hundred and twenty yards of coal (equal to one hundred and thirty tons) holed by the Gartsherrie coal-cutter:

No. of Men.	Cost. s.	d.
24 Hewers (per ton)	1	5
8 Deputies "	0	5
6 Putters "	0	2½
6 Men at cutters	0	3½
3 Brake and foremen	0	1½
2 Men repairing cutter-chain	0	1½
49	2	7½

To get the same quantity of coal by hand-labor from the same colliery would require:

No. of Men.	Cost. s.	d.
67 Hewers (per ton)	3	3
6 Putters "	0	2½
6 Deputies "	0	3½
79	3	9½

Showing a difference in favor of the coal-cutter of 1*s.* 2*d.* per ton. Taking the best performance of the coal-cutter as the basis of calculation, and extending its economical showing over the total production of the United Kingdom, the fact may be considered as demonstrated that if machine work were universally adopted, there would be a saving of at least £6,000,000 effected in raising the 120,000,000 tons of coal now annually produced in that country. So favorable a showing can, however, hardly be anticipated in this country, save perhaps in the future development of our Western coal-fields.

NOTE TO ASTRONOMY.

(*Added January* 20, 1875.)

Since the preceding pages were electrotyped, the two following discoveries have been announced as having occurred prior to the end of the year 1874:

ASTEROID.

No. 139.—Discovered October 10, by Professor J. C. Watson, at Pekin, China.

COMET.

1874.—VI. Dircovered December 6, by Borelly, at Marseilles.

OBSERVATIONS OF THE TRANSIT OF VENUS.

From the telegraphic and other reports that have reached us concerning the success of the observations on the eventful 9th of December (the evening of the 8th at Washington), we gather that although the weather was in general not all that could be desired—in fact, rather unfavorable—yet there have been secured observations abundantly sufficient to materially advance our knowledge of the solar parallax. It may be fairly inferred from the meagre telegrams that have reached us that the phenomena of the black drop or ligament, that so sorely annoyed the observers of the last century, has in the present case caused comparatively no annoyance—that, in fact, it has only rarely been observed, and its disappearance is undoubtedly in great part due to the more perfect defining power of our modern telescopes. If we, for brevity, classify the stations into two orders, the successful and the unsuccessful, we shall have the following record. We consider as a successful station one that obtained observations that could be of any value in deducing the final result.

UNITED STATES: *Successful* at Hobart Town, Nagasaki, Campbell Town, Pekin, Vladivostock, Bluff Harbor.

ENGLAND: *Successful*, Cairo, Suez, Thebes, Alexandria, Honolulu, Atooi, Malta, Roorkee, Rodriguez.
Unsuccessful, New Zealand, Owhyhee.

FRANCE: *Successful*, Pekin, Nagasaki, Hiogo, Robe.

RUSSIA: *Successful*, Teheran, Thebes, Vladivostock, Port-Posséet, Tschuita, Nertschinsk, Chabarovka, Orlanda, Kiachta, Ispahan, Yokohama.

Unsuccessful, Omsk, Astrachan, Naratov, Tiflis, Blagovetschusk, Orenburg, Kasan, Uralsk, Kertsch, Erivan, Nakitschevan.

GERMANY: *Successful*, Ispahan, Thebes, Cheefoo, Mauritius, Auckland Islands.

AUSTRALIA: *Successful*, Melbourne, Adelaide, Sydney.

INDIA: *Successful*, Calcutta, Kurrachee, Indore.

Unsuccessful, Madras.

AUSTRIA: *Successful*, Jassy, Klausenburg.

HOLLAND: *Successful*, Isle of Réunion.

COLONEL CAMPBELL (private station): *Successful*, Thebes.

LORD LINDSAY (private station): *Successful*, Mauritius.

ANNUAL RECORD

OF

SCIENCE AND INDUSTRY.

1874.

A. MATHEMATICS AND ASTRONOMY.

PROBLEM OF THREE BODIES.

THE problem of the motion of a point attracted by two fixed points, which was first solved by Euler in 1760, has subsequently formed the theme of numerous studies by the most eminent mathematicians, and has recently been made the subject of investigation by Perlewitz, who has paid especial attention to the case where the moving point moves in a plane and describes either an ellipse or a hyperbola, whose foci are represented by the two fixed points. The formulæ arrived at by Perlewitz seem quite rigorous, and have been deduced by the use of the so-called Theta function in the theory of elliptic integrals. Among other curious results, Perlewitz finds that, in the case of elliptic motion, the eccentricity of the ellipse is the square root of the sum of the masses of the two attracting points divided by the sum of the major axis. —*Inaugural Dissertation, Leipsic*, 1872.

THE NATURE OF THE SPIRALS OF THE NAUTILUS.

One of the most interesting applications of mathematics to problems in natural history consists in the investigation of the nature of the spiral curve, which we obtain when we make a fine section of the winding shells of the various shell fishes, especially the shells of the nautilus, and other allied

forms. The literature of this subject has, in fact, grown to be quite voluminous, since the first papers that were published by Moseley and Naumann, thirty years ago. The conch shells, according to both these authors, are based upon a spiral curve that is sensibly identical with the so-called logarithmic spiral; but, subsequently, Naumann adopted the theory that the spiral was one peculiar to the animal building the shell, and he therefore proposed the name of the concho-spiral. The subject has lately been investigated by Grabau, and apparently with very great ability. He states that he has sought to determine whether it were possible, if not in theory, at least in practice, to confound the concho spiral and the logarithmic spiral; and then again, to determine whether, allowing the possibility, some of the observers had not actually erred in this very direction. His very thorough mathematical investigation, and equally laborious mathematical computations, lead to the conclusion that, from the totality of Naumann's calculations, an unprejudiced critic must conclude in favor of the reality of the concho spiral, so far, at least, as this is possible from the diameters and measures given by him; and one can but suspect that, if not all conchs, at least some, and decidedly the most, have actually built upon the concho spiral, and that only the fact that the asymptotic circle of this curve is frequently too small has favored the assumption that, in these cases, the shell has followed the logarithmic spiral.—*Inaugural Dissertation, Leipsic*, 1872.

THE LENGTH OF THE EGYPTIAN CUBIT.

The earnest labors and writings of Professor Smythe, Astronomer Royal for Scotland, have succeeded in drawing attention to the importance of the accurate determination of the value of the units of length, weight, and volume that were formerly in use in Egypt. There can at last be no doubt but that the measures in use by us in modern times, excepting of course the French metric system, are a direct inheritance from the days of the early Egyptians; that, in fact, the measures used by the Hebrews were identical with those of Egypt, and that there is a remarkable similarity even between the ancient measures of China, Assyria, and Egypt. Although much has been written to controvert the positions taken by

Smythe in his remarkable work, *Our Inheritance in the Great Pyramids*, yet there seems to be a gradual conversion to his views, or to views not materially different from his, if we may judge from the remarks of Sir Henry James on the Greek and Egyptian measures of length, recently published by the Royal Society as prefatory to some elaborate measures made by Colonel Clark, of the Ordnance Survey. Although we believe the conclusions of Sir Henry James with reference to Egyptian metrology are open to some criticism, it will nevertheless be interesting to reproduce them in this place. According to him, not only are our own measures derived from those of ancient Egypt, but all the accurate results given in the most ancient works on astronomy and geodesy are expressed in units of measures that depend more or less directly upon those of Egypt. The ancient Egyptians employed two measures of length; namely, the common and the royal cubit. Of the latter, ten specimens have been found preserved in the ancient buildings of Egypt, the most perfect of which is that now in Florence, which is a slab of slate or schist. The other nine examples are of wood, and are generally divided into seven palms, apparently with a fine saw, with as much or even greater accuracy than the generality of the measures with which the workmen of the present day are supplied. Of the common cubit there seems to be no simple specimen now extant; but, on the other hand, the dimensions of some Egyptian monuments are known in terms of the ancient common cubit, so that its value can be restored. Sir Henry James concludes that the length of the royal cubit is 20.727 English inches; the length of the common cubit appears to have been 18.240 inches. Sir Henry James suggests that it is not unlikely that the common and royal cubits had some definite relation to each other, like that between the link and foot of surveyors' measures in our own country, and he infers that probably eighty-eight royal cubits of Egypt were equal to a hundred common cubits of that country. The length of the English foot is exactly the average of the ancient Egyptian common and royal foot, although it is probably so by accident only.—*Phil. Trans. Roy. Soc., London*, 1874, CLXIII., 445.

RESEARCHES IN THE GREAT PYRAMID.

The investigations that have of late years been made into the mysteries of the Great Pyramid of Ghizeh, have received a great impetus from the accurate measurements and studious labors of Professor Piazzi Smythe, director of the observatory at Edinburgh. Professor H. L. Smith has also taken up the subject, and communicates to the *Journal of Science* many interesting comparisons and coincidences that have occurred to him, his reports being based mostly upon the measurements of his predecessors. Professor Smith has opened a new path of investigation in giving special attention to the "Queen's Chamber," as distinguished from the so-called "King's Chamber," and the passages leading thereto, on which Piazzi Smythe and others bestowed most of their study. It may be known to some of our readers that on entering the Pyramid at the opening most easily accessible to visitors, one passes down nearly to the level of the base of the monument, and then rises at an equal angle to the level of the King's Chamber. Half-way up the ascent to this chamber we proceed along a horizontal passage-way to the Queen's Chamber, which is situated more nearly in the very heart of the structure. While Professor Smith is very cautious in expressing any opinion as to the original design of the Pyramid, we may safely conclude that he is almost persuaded to believe that the Great Pyramid was designed for the preservation of certain important metrological standards, and for the purpose of perpetuating in stone to all time some remarkable astronomical truths and high mathematical calculations. As to the source whence the builders of the Pyramid derived their knowledge we can only speculate; yet it seems necessary to admit the fact that they actually were in possession of it, whether as the result of their own unaided investigations, or actually given to them by inspiration. The unit of measure adopted by the Pyramid builders seems to have differed but very little from the British inch—926 British inches being equal to 925 Pyramid inches. The ancient builders appear to have endeavored to establish the Pyramid exactly in latitude 30°; and in their endeavor to do so have found it necessary to extend to the northward the boundary of the hill on which it was established, having

used the chippings of the stones for this purpose. From the dimensions and position of the Queen's Chamber, Professor Smith concludes that the builders employed the star *Alpha Draconis*, and *Eta Tauri*, the brightest star of the Pleiades, as the starting-point in their astronomical measurements, and that the time of building must have been about the year 2100 B.C. This latter date, however, depends entirely upon modern astronomical measurements, which, it must be remembered, do not afford so secure a basis for a retrospective calculation of this nature as is necessary to an accurate determination of the very century in which the Pyramid was built. In certain relations between the dimensions of portions of the Queen's Chamber, Professor Smith finds evidence that the builders were acquainted with what is known as the ratio of the circumference to the diameter of a circle to within the one-millionth part of its value.—4 *D*, 1873, II., 330.

TESTING WEIGHTS IN ENGLAND.

According to *The Academy*, a balance has been placed at the entrance gate of the Royal Observatory at Greenwich, which shows, by means of an index on a large divided arc, how many grains too light or heavy any ordinary pound weight may be. Any one, therefore, has it in his power to test his weights, and to determine whether they are accurate or not.—13 *A*, *February* 7, 1874, 151.

MORPHOLOGY IN ARCHITECTURE.

At one of the recent sittings of the Academy of Fine Arts in Paris, M. Hugo, member of the Mathematical Society founded at Paris since the war, presented to the Section of Architecture a morphological theory, which he considers as fundamental. This theory undertakes, according to him, to show mathematically the connection between the polygonal figures which are so frequently employed in monumental constructions. These figures are derived from the pyramid, and, according as the solids in question are more or less massive than the pyramid, they are divided into domoids and tremoids. If we increase the number of faces, we arrive at the solid of revolution just as we pass from the prism to the cylinder. The new and very remarkable figure which generates the sphere has received the name of equi-domoid.

The cupola of Brunelleschi, which crowns the Duomo of Florence, is an equi-domoid. M. Hugo thinks that the theory of the sphere has no independent existence, and that it is the simple geometric corollary of the equi-domoid. The passage from the pyramids of Euclid's geometry and of the Egyptian architecture to the spheres of modern geometry and the domes of modern architecture, M. Hugo calls the morphology of architecture.—*Introd. to Descriptive Geometry.*

THE INTEGROMETER.

The integrometer is the name of an instrument designed by Deprez, a civil engineer of France, for the purpose of finding the area, the curvature, the centre of gravity, and the moment of inertia of any plane figure whatever, almost without calculation; it is an extension of the instrument known as Amsler's planimeter, now extensively used by engineers and draughtsmen. The instrument consists essentially of a fixed ruler along which a slider can move freely: secondly, of a straight rod, which is freely pivoted on the slider, and which carries at one end a pointer, that is made to trace the contour of the given figure; at the other end it carries a stirrup, between the prongs of which a horizontal axis extends with which a wheel is connected. This wheel is divided into one hundred parts. As the pointer traces the contour of the given figure, the wheel rolls over the plane surface in a peculiar manner, such that the length of the arc through which the wheel turns, multiplied by the length of the arm of the rod, gives the area of the figure whose contour has been traced. By a special arrangement of the instrument, the centre of gravity of this contour and its moment of inertia are also given. In short, the instrument serves to economize time and labor in dealing with the numerous problems that occur in engineering, in relation to irregular, closed contours.—*Professional Papers on Indian Engineering*, III., II., 8.

STELLAR PARALLAXES.

Professor Brünnow, director of the Observatory of Trinity College, Dublin, has, as is well known, devoted his energies of late years to the determination of the relative parallaxes of the fixed stars. Many suitably placed stars have been observed by him, and the recent Annals of the Observatory

at Dunsink show that the distinguished astronomer is attaining results of the highest accuracy, which must be classed among the most trustworthy of all the data possessed in this, the most difficult field of astronomical investigation. One of the most interesting stars in the heavens is that generally known as No. 1830 of Groombridge's Catalogue, whose large proper motion was discovered by Argelander in the year 1842. This star has since that time been the object of several series of observations made for the purpose of determining its parallax. The results obtained by Peters, Wichman, and Otto Struve have all established beyond reasonable doubt that the parallax of this star is much smaller than might be expected from its large proper motion; and the new series of observations made by Dr. Brünnow, while confirming this general conclusion, has conduced to fix the exact value of the parallax within very narrow limits. As is well known, the determination of relative parallax is obtained either by measuring the angular distance between the star under investigation and other very faint stars in its immediate neighborhood, or else by observing the position angles of the lines joining such stars. Dr. Brünnow has adopted the former of these methods of observation, having selected his comparison stars in such positions, with reference to the central star, that the systematic errors committed in making observations should have opposite influences upon the resulting parallax. He concludes that the observations indicate a parallax of nine hundredths of a second for the star in question. A similar series of measurements was made upon the star *Sigma Draconis*, for which body a parallax of about one fourth of a second seems to be well established. For the double star No. 85 *Pegasi* he deduces the interesting result that there is possibly a difference in the value of the constant of aberration for the two components of the star, with which assumption there follows a parallax of five hundredths of a second, a result, however, which demands further investigation. For the double star No. 3077, of Bradley, he deduces a parallax of seven hundredths of a second. An investigation of the parallax of *Alpha Lyræ*, or *Vega*, leads to a value not materially different from those found before by other observers, but which has intrinsically less weight than the other determinations attained by him, inasmuch as the observations

seemed to demand the assumption of a very large and quite improbable difference in the value of the constant of aberration for the two stars that come under the observation. In general, it will be noticed that none of the stars as yet examined by Dr. Brünnow have revealed any large parallaxes, and the problem of determining the distances of the fixed stars by means of angular measurements promises still to remain the most difficult and vexatious of those whose solution is attempted by the astronomical observer.

GILLISS'S SOUTHERN ZONE OF STARS.

Admiral Sands, in his annual report with reference to the work of the Naval Observatory, states that observations to be of any value to the world must be published. If they are not, the time and labor spent upon them are simply wasted; and yet they are so much more easily made than reduced, that nothing is more common than to see them lie hidden for years before the computations necessary to fit them for publication are completed. The Naval Observatory has been enabled to resuscitate from its store-rooms the zones of stars observed by Captain Gilliss, in Chili, in 1850–52, and their reductions are now in such a state of forwardness that the resulting star catalogue will appear in 1875, in the volume of Washington observations for 1873. Thus it will be seen that all the valuable records which were at one time locked up in the archives of the observatory will soon have been given to the world.—*Report of the Sec. of the Navy*, 1873, 97.

THE MOVEMENTS OF THE NEBULÆ.

Mr. Huggins, of London, whose observations on the motions of some stars toward and from the earth have long been quoted as the first contribution ever made to our knowledge of this subject, states that for the last two years he has been giving considerable attention to a similar inquiry in connection with the nebulæ. His method of observation, as is well known, consists in comparing the lines in the spectra of the heavenly bodies with the corresponding lines in the spectra of terrestrial substances. In his observations on the nebulæ, he has compared a certain line in a spectrum of lead with that line in the nebula which is supposed to belong to the spectrum of hydrogen; each nebula being observed on sev-

eral nights, so that the whole observing time of the past year was devoted to this inquiry. In no instance was any change of relative position detected in the positions of the lines of the nebulæ and the lead. It follows that none of the nebulæ observed show a motion of translation toward or from the earth so great as twenty-five miles per second, including the earth's motion at the time. The observations seem to show that the gaseous nebulæ, as a class of bodies, have not "proper motions" so great as many of the bright stars. Since the existence of real nebulæ has been established by the use of the spectroscope, Messrs. Abbe, Proctor, and D'Arrest have called attention to the relation of position which the gaseous nebulæ hold to the Milky Way and the sidereal system. It was with the hope of adding to our information on this point that these observations of the motions of the nebulæ were undertaken. Mr. Huggins gives the results of observations on seven different nebulæ only; and it is to be hoped that, notwithstanding the discouragement which he experiences on account of the unfavorable atmosphere of England, he will continue his researches in this difficult branch of observation.—12 *A*, 1873, IX., 454.

THE DOUBLE STAR PROCYON.

Concerning the minute companion star to Procyon, whose existence has lately been discovered by Otto Struve, the eminent Russian astronomer, he states that there can now be no longer any doubt that this companion is, in fact, the perturbing body which for many years past has been known to be deranging the movements of the brighter star. It is necessary to assume, for Procyon, a mass eighty times as great as that of our sun, and for the companion a mass at least five times as great as that of the sun. The observations of the past few months by Otto Struve have shown that the companion star is now within a degree of being in the position predicted by Auwers a year ago.—12 *A*, 1874, X., 37.

REMARKABLE STELLAR SPECTRUM IN THE MILKY WAY.

D'Arrest, the director of the observatory at Copenhagen, in some remarks on the nature of the spectra of certain stars and nebulæ, calls attention to the spectroscopic revision of the Milky Way, a work with which he has been for some time

occupied, and states that in the course of this examination he has fallen upon a very remarkable star of the eighth magnitude, known as No. 4203 of Argelander's *Durchmusterung*, in north declination 22°. Concerning this star, he remarks that its spectra is the most remarkable of all the thousands that he has hitherto studied, and he suggests that, possibly, it will be found hereafter that this is a variable star. The work on which D'Arrest appears to be engaged is evidently of such a nature as will eventually greatly further our knowledge of the constitution of the universe. —*Astron. Nach.*, LXXXIII., 16.

THE SCINTILLATION OF THE STARS.

In a memoir by Montigny, it is endeavored to show that the frequency of variations of the colors of stars in scintillation has generally a relation to the constitution of their light according to spectrum analysis. The author's observations embrace sixty-six nights, in the years 1871 and 1873, and he gives a table of the stars observed, arranging them according to the types of their spectra as given by Secchi. The number of scintillations observed in one second, at the zenith distance of sixty degrees, is also given, as well as the magnitude of the star. Montigny finds that the stars scintillating most belong to the first type of spectra, or those having four spectral lines; while the stars showing weak scintillation generally belong to the third group, or type of nebulous bands and dark lines. The average number of scintillations in the first type is eighty-six; considerably exceeding that of the third, which is fifty-six. The average of the second group is sixty-nine. These are the stars whose spectra resemble that of the sun. No marked connection appears between the frequency of the scintillation and the brightness of the stars. The red stars scintillate less than the white ones, as first pointed out by Dufour. This he explains as due to the fact that, with equal distances from the zenith, the total separation of the colored bundles of rays dispersed by the atmosphere, and which have emanated from a white star, is greater than in the case of a red star; the original rays of the white star being more numerous and more exposed, so as to undergo more frequent interception by the passage of aerial waves. —12 *A*, 1873, IX., 493.

THE COMPUTATION OF ABSOLUTE PERTURBATIONS.

Mr. G. W. Hill, of the American Nautical Almanac office, calls the attention of astronomers to the notable abbreviations which are produced in some parts of the formulæ for perturbations, by the introduction of the true anomaly as the variable according to which integrations are to be executed. Professor Hansen, in his later disquisitions, has substituted the eccentric anomaly as the independent variable in place of the mean anomaly (or, what is the same thing, the time), and he regards this step as constituting a remarkable amelioration of the method. The method proposed by Mr. Hill, on the other hand, employs the same co-ordinates as did Laplace, but makes use of the true anomaly in the elliptic orbit as the independent variable.—*Astron. Nach.*, LXXXIII., 211.

RECENT OBSERVATIONS ON THE SOLAR PHOTOSPHERE.

Professor Langley, of the Alleghany Observatory, near Pittsburgh, has devoted some years to the special study of the minute structure of the solar photosphere, especially to the nature of the appearances which Mr. Nasmyth likened to willow leaves, and which Messrs. Stone and Donkin compared to rice grains. The difficulties of observation are, in fact, extreme; but Mr. Langley determined to rely only upon the direct telescopic study of the minute components of the photosphere, thus forming a distinct point of view from that taken by the spectroscopists. Most of the minute phenomena described by him are unrecognizable, except with telescopes of large apertures. The equatorial used by him has an object-glass of thirteen inches' diameter, and its full aperture has been available only through the use of a most valuable accessory for such study—namely, the polarizing eye-piece, which presents a solar image free from unnatural color, and of any brightness desired. The most formidable difficulty in the way of satisfactory observations arises from the disturbances of our own atmosphere, and for this there is no remedy but assiduity and patience. The drawing prepared by Professor Langley, a photograph of which accompanies his memoir, is by far the most minutely accurate of any that has ever yet been published, and most of the minutiæ given in it can be seen, he states, only in exceptionally favorable conditions of

the atmosphere. In general, when we look at the solar disk, we perceive that it has a nearly uniform brightness, excepting, of course, the trains of spots that are scattered across it in zones parallel to the solar equator, and the irregular white patches called faculæ. A more attentive examination shows that the surface of the sun, even near the centre where neither faculæ nor spots are visible, is not absolutely uniform, but is made up of fleecy clouds, whose outlines are all but indistinguishable. Under more painstaking scrutiny, numerous faint dots on the white ground were observed, producing the impression of a moss-like structure in the clouds. With high magnifying powers, used in favorable moments, the surface of any one of the fleecy patches is resolved into a congeries of small, intensely bright bodies, irregularly distributed, which seem to be suspended in a comparatively dark medium, and whose definiteness of size or outline, although not absolute, is yet striking by contrast with the vagueness of the cloud forms seen before, which vagueness we now perceive to be due to their aggregation. The dots referred to are considerable openings, caused by the absence of the white nodules at certain points, and the consequent exposure of the gray medium which forms a general background. These dots or openings have been called pores. The diameter of the more conspicuous varies from two to four seconds. The bright nodules are neither uniform in shape nor in brightness. The outline is irregular, but, on the whole, affects an elongated or oval contour. Mr. Stone has called them rice grains, a term appropriate only when we view them with a telescope of three or four inches' aperture. In moments of rarest definition, Professor Langley has been able to resolve these rice grains into minuter components, which he calls granules, whose diameter can hardly equal 0.3″. From these granules comes by far the largest portion of the sun's light. Their number varies widely; there being commonly from three to ten in each rice grain, and their area is such that the properly luminous area of the sun is less than one fifth of the whole solar surface. We must, then, greatly increase our received estimates of the intensity of the action to which solar light, heat, and actinism are due.

With reference to the study of the solar spots, properly so-called, Professor Langley shows that in the penumbra there are

not only numerous small cyclones, and even right and left handed whirls in the same spot, but probably currents ascending nearly vertically, while the action of superposed approximately horizontal currents is so general that they must be considered a permanent feature in our study of solar meteorology. The outer penumbra is, he concludes, formed by a rupture. The penumbra is all but wholly made up, as it appears in a first examination, of cloud-like forms, whose structure makes them seem like fagots or sheaves, which Mr. Dawes has compared to bundles of thatch; while Mr. Langley resolves these sheaves into filaments of extreme tenuity, which he thinks have a tendency to lie in sheets or folds, causing this decrease of brightness. The normal darkness of the outer penumbra is nothing else than the darkness of the gray medium in which the granules float all over the sun, though much deeper tints are here and there found, which sometimes make the penumbra itself resolvable into a ring of little spots. There seems to him no room to doubt that filaments and granules are names for different aspects of the same thing; that filaments in reality are floating vertically all over the sun, their upper extremities appearing at the sun's surface as granules; and that in the spots we only see the general structure of the photosphere as if in sections, owing to the filaments being here inclined. The average distance from centre to centre of the filaments is less than one second. —4 *D*, 1874, VII., 87.

PHOTOGRAPHS OF THE SOLAR SPECTRUM.

Dr. Henry Draper, of the New York University, communicates the highly valuable results obtained by himself in attempting to photograph the diffraction spectrum of the solar light. The photographs published by him are of remarkable clearness, and must be considered as an important advance over the spectra that have hitherto been drawn by the hand alone. In the finest maps drawn by hand, such as those of Angström, the relative intensity and shading of the lines is but partially represented, and a most laborious and painstaking series of observations and calculations is necessary, in order to secure approximately correct positions of the multitude of Fraunhofer lines. Thus, for instance, Angström, in a certain portion of his spectrum, shows 118 lines, while Dra-

per's photograph gives 293. The diffraction plate used by Dr. Draper was prepared for him by Mr. L. M. Rutherford, by a machine devised and constructed by that well-known amateur. It consists of a plain glass surface, a portion of which, equal to about one square inch, is ruled with a fine diamond point with 6481 lines to the inch. Owing to the fineness of details brought out by Draper's photographs, he is justified in the statement that the exact composition of even a part of the spectrum of any metal will not be known until we have obtained photographs of each on a large scale. —4 *D*, 1873, VI., 400.

THE SOLAR PHENOMENA.

M. Gautier has given a résumé of spectroscopic observations on the solar spots made at Geneva during the past three years. His results are mainly a confirmation of those of other observers. The protuberances are classed under three heads: as eruptions, exhalations, and detached formations. Like Father Secchi, he was often struck by the fact that when a protuberance is observed near either pole there is generally one symmetrical with it at the other end of the corresponding solar diameter, and near the opposite pole.

The decrease in the number and dimensions of protuberances appears to precede and exceed that of the spots. Gautier adheres to the hypothesis of spots being formed by scorial matters, resulting from cooling of the surface by radiation.—12 *A*, 1873, IX., 494.

EFFECT OF TEMPERATURE OF THE SPECTROSCOPIC APPARATUS ON THE SOLAR SPECTRUM.

Mr. Hennessey has made some observations to determine the amount of displacement in the solar spectrum arising from changes of temperature. The spectroscope was set up on a pillar within a small tent, at a time of the year when the thermal range is considerable. The result of the series shows that a displacement equal to four divisions of Kirchhoff's scale are produced by a change in temperature of thirty degrees, from which it appears that this subject may not be neglected in investigations made under a considerable thermal range.—*Pr. Roy. Soc. of London*, XXII., No. 150.

CHANGES IN THE SOLAR SPOTS.

The latest communication from Messrs. De La Rue, Stewart, and Loewy, in reference to their joint work on the solar spots, communicates an entirely unexpected discovery, to the effect that, during periods of great disturbance, there is a tendency in the spots to change alternately from the northern to the southern hemisphere, and *vice versa*, the period of such change being about 25 days. On the other hand, it is only when the solar disturbance is inconsiderable that the spots do not present any such systematic oscillation. Connecting this generalization with the previous discoveries of Carrington, as well as with their own, they conclude that it is demonstrable that outbreaks probably occur in pairs, at opposite ends of the same solar diameter, at an interval of twelve or thirteen days.—*Pr. Roy. Soc.*, 1873, 401.

SOLAR SPOTS AND SOLAR REFRACTION.

Lohse, of Bothcamp, has communicated to the *Astronomische Nachrichten*, a valuable memoir, both theoretical and observational, on the determination of the depth of the sun-spots and the amount of solar refraction. He has attempted to add something to our knowledge of this subject by a series of micrometric measures made upon the solar spots at various distances from the limb of the sun, following out the idea published just one hundred years ago by Wilson, of England, and which may be expressed as follows: "By measuring the distance of the edge of the spot from the solar limb at the moment when the side of the umbra is just hid or begins first to come in view, the inclination or declivity of the spot may in some measure be obtained." But few opportunities have offered themselves to Lohse to make such measures relating to this phenomenon; and the first result to which he has been led has been the development of a systematic discordance that can not possibly be referred to errors of observation, but can be explained as the result of refraction in the solar atmosphere. A discussion of observations made with reference to the same point by Secchi, leads also to a decision in favor of the assumption of a perceptible refraction even in the upper strata of the solar atmosphere.—*Astron. Nach.*, LXXXIII., 114.

THE SOLAR PARALLAX.

At the April meeting of the Royal Astronomical Society, Lord Lindsay, after giving a description of the form of instrument which he has devised for taking photographs during the coming transit of Venus, read a paper on a method of determining the solar parallax from observations to be made at the next opposition of the asteroid Juno, which occurs in November of this year. He proposes, while stationed in the Mauritius for the purpose of observing the transit of Venus, to take advantage of his position to make a series of heliometric measures of the distance of Juno from the nearest fixed stars, and, by comparisons between the measures taken soon after Juno has risen above the eastern horizon with those taken before it sets at the western, to determine the terrestrial parallax. By this method he will be able to make his measures, during all the clear nights of the period, for six weeks before and after the opposition of the planet; and, although the parallax will be considerably less than in the case of Venus, he considers he has reason to hope that the probable errors of the result will be less, owing to the number of measurements, and the ease of dealing with points of light instead of disks, than they are in the case of the transit of Venus or the opposition of Mars.—12 *A*, 1873, IX., 475.

THE NATURE OF THE SOLAR SPOTS.

Professor Spörer, the well-known observer of the solar spots, makes a comparison between the spots observed by himself and the protuberances depicted by the Italian spectroscopists Secchi and Tacchini, and shows in numerous examples their agreement with conclusions which he developed in 1871; namely, that the solar faculæ occur on the same spots where flame-like protuberances exist, or where the so-called flame chromosphere occurs; and, again, that these protuberances in most cases stand in such a connection with the dark spots that the former are much more important before and at the time of the origin of groups of spots than they are subsequently; and, finally, there are many cases where the spots are subsequently found in precisely the same region where previously were notable flame-like protuberances. Indeed, he adds, even before spectrum observations were instituted, it

was already known that all the more important spots and groups of spots only occur where faculæ had already been found. From the great intensity of the flame-like protuberances, he concludes that the faculæ must be looked upon as the hot portions of the surface; thence it follows at once that, above them, ascending currents of air must exist, and that from all sides the cooler air must stream toward these hot portions. If the ascending currents reach to the colder strata of air, the resulting precipitation brings about dark clouds. Even after the formation of these clouds the ascending and horizontal currents still continue, giving rise to the intense bright veins that are seen running through groups of spots. The only indication of storms in the lowest strata to which he gives any weight is found in the observed deviations of the tips of the chromospheric flames. If, he states, an upward current is instituted in the solar atmosphere, some of the higher masses of air must necessarily descend; therefore there must somewhere, at some altitude, occur a contest of currents giving rise to horizontal currents, such as he has observed in at least four instances.—*Astron. Nach.*, LXXXIII., 90.

THE CONSTITUTION OF THE SUN.

Messrs. Wilson and Seabroke, having made a long series of observations, at Rugby, on the solar protuberances, and finding that they preponderate greatly in the equatorial region of the sun, where the spots also predominate, have offered some brief remarks on a new theory of protuberances and spots. Their theory assumes that, at some distance below the sun's surface, the pressure is such that substances, such as some metals, are in a liquid state, though at a temperature far exceeding their boiling-point under ordinary pressure. In this case the compressed liquids will, on the whole, arrange themselves in the order of density. If the pressure be diminished, these will burst into vapor. The equilibrium is, therefore, unstable. Consequently it is assumed that there may exist in the sun two or more liquids, so related that the denser has the lower boiling-point. If these disturbances of pressure occur, they will produce vertical eruptions through the upper layers of the sun, throwing up the chromosphere and photosphere into jets, such as are observed. The sub-

stances thrown up, as they fall, will produce a region of general and also selective absorption. When any portion of the descending material is liquid, the general absorption will be great. This will then form the centre of the spot. In following out their theory, the authors adduce numerous points of detail in which observations sustain their views.—*Monthly Notices Roy. Ast. Soc.*, XXXIV., 26.

THE VARIABILITY IN THE DIAMETER OF THE SUN.

The investigation of a possible change in the solar diameter, coincident with the changes of solar spots, has been revived by Wolf, of Zurich; and, while giving full weight to the conclusions of Wagner and Auwers, he recalls a half-forgotten work of his own, undertaken many years ago; and shows that, in spite of the negative results arrived at by Auwers, we are still justified in drawing the conclusion that, at least in Maskeleyne's observations, there are very plain traces of the existence of a solar-spot period, and that Secchi's conclusions are possibly correct, although the basis for them adduced by him was quite unsatisfactory. The curves given by Wolf show that, as the number of solar spots increases, the solar diameter diminishes.—*Wolf's Astron. Mitth.*, No. 34, 134.

THE VARIABILITY OF THE SUN'S DIAMETER (AGAIN).

The investigations of Father Secchi, based on the short series of observations made by Father Rosa, and which led him to the conclusion that there was a variation in the sun's diameter coincident with the variations in the spots and protuberances, have led to an exhaustive and valuable article by Dr. Auwers, who shows, first, that Secchi had no good reason to draw his conclusion from the somewhat inaccurate observations of Rosa; and, furthermore, by an extended investigation of all the observations available, made at other observatories during the same period of time as that embraced by Rosa's observations, he proves that there is conclusive evidence as to the non-existence of any variation of the solar diameter at this time, and that the changes noticed by Secchi must have been due to casual errors of observation. Pursuing the subject still further, Auwers has also examined the long series of Greenwich observations made since 1750,

and concludes that, in the fluctuations of the observed values of the horizontal and vertical diameters of the sun, no dependence upon the variations of spots can be perceived.—*Monthly Notices Roy. Ast. Soc.*, 1873, XXXIV., 22.

THE TEMPERATURE OF THE SUN.

The latest investigation on the temperature of the sun, by Father Secchi, has been recently published, and he concludes that the lowest limit of this temperature must be about 133,000° Centigrade. He has arrived at this determination by a comparison of the solar radiation and that of the electric light. He has employed the same apparatus (the thermoheliometer) described in his well-known work on the sun. The temperature produced by solar radiation was observed at Rome, about noon, on several days in July, and was determined to be 36½ times that of the carbon points of his electric light. Both Secchi and Hirn agree that the temperature of solar radiation may depend either solely on the superficial stratum of the sun, or on a considerable thickness of its substance, according as this latter is opaque or transparent. Hirn concludes that if the transparence were nearly perfect, the solar temperature might well be only a few thousand degrees; but various phenomena, among them the observations of Professor Langley, of Pittsburgh, on the crossing of the currents of the photosphere, show that the solar surface is essentially opaque, and certainly at the best is not completely transparent. The very high temperature of 130,000° to 170,000°, above given, is, therefore, not inadmissible, but may be looked upon as at least giving a lower limit to the true value of the temperature of the sun.—7 *A*, 47, 394.

ON SOLAR RADIATION.

In regard to the use of thermometers for determining the intensity of solar radiation, Mr. Stow has recently been making a number of observations, the report on which is about to be published. He expresses his own opinion, in a preliminary manner, as follows: "Looking at the subject attentively, there are three different objects which meteorologists may propose to themselves in attempting to measure the sun's heat. The first is the measurement of the intensity of

the solar rays, irrespectively of the duration of sunshine, and of the angle at which the rays strike the ground. This should be measured by the excess of the reading of the thermometer, with blackened bulb, *in vacuo*, freely exposed to sun and air, above the temperature of the air and shade. The second is the total heating effect upon a large mass of earth or water, also irrespective of the angle of the incidence of the sun's rays, but depending both upon the intensity and duration of the sunshine. This may be measured by inserting a thermometer into the centre of a hollow sphere, such as a sixty-eight-pound shell, which might be filled with water, and should be elevated above the ground. The third is the heating effect produced upon the earth's surface, depending upon the altitude of the sun, as well as upon the intensity and duration of sunshine, not to mention moisture, evaporation, etc. This may be measured by a thermometer, not *in vacuo*, placed upon the ground, or, still better, perhaps, by one buried just below the surface of a level sand-bed." It is to the first of these, viz., actinometry, that he had directed attention; and while not saying that the other investigations are not equally important, he thinks it best not to obtain figures which represent the action of a variety of causes, the individual effect of which is unknown; but of one cause only, and afterward to proceed to the investigation of two or more causes combined.—*Quar. Journ. Meteor. Soc., London*, 2–27.

THE SOLAR ECLIPSE OF 1870 IN ITALY.

The report of the observations made by the Italian astronomers on the solar eclipse of December 22, 1870, has been received in this country. It will be remembered that, in order to assist in the observations of this important eclipse, Professors Newcomb, Hall, Harkness, and Eastman were sent, at the expense of the government, from the Naval Observatory at Washington, to occupy proper stations in Spain and Sicily. Their reports were promptly published by our own government. The Italian government, on the other hand, represented by the numerous astronomers of that nation, among whom the names of Secchi, Donati, Denza, and Tacchini are well known in America, occupied two stations, each manned, as we may say, by six of the most experienced astronomers of the nation, and by a number of assistants. The observa-

tions at these stations were divided into those preliminary to and succeeding the eclipse, and those made during the eclipse, to which should be added the magnetic and meteorological observations. During the eclipse proper, besides the exact observation of the time of beginning and ending of each phase, a special interest centres in the appearances observed during the few minutes of total obscuration. The attempts to photograph the various features of the eclipse seem to have been quite successful, having been accomplished by means of an instrument of large dimensions by Dallmeyer, the same which had been used by De La Rue in Spain in 1860. By virtue of the necessity for a subdivision of labor during the brief interval of the duration of the total eclipse, the chronometric determination of the time was assigned to Professor Donati; the photometric operations were conducted by Professor Secchi. The polarization of the solar corona was observed by Professor Blaserna, who made use of a Savart polariscope, in which the tourmaline plate was replaced by a Nichols prism. His results were among the most interesting that have been recorded in connection with the solar phenomena. He states that the influence of the terrestrial atmosphere was feeble; that the solar corona was strongly polarized; and that the plane of polarization was in the direction of a tangent to the limb of the sun. These positive results from the hands of an experienced observer are especially interesting, in consideration of the numerous contradictory and fruitless observations made by many others. The observations of the protuberances seen during the period of totality were assigned to Professor Denza, who was armed with a spectroscope attached to a large refracting telescope constructed by Merz, of Munich. The meteorological and magnetic observations were also under the general care of Professor Denza, and embraced every element of terrestrial and atmospheric physics that could be observed. It is well known that he has recently deduced an apparent dependence of certain changes in magnetic instruments upon the occurrence of this eclipse.

The preceding observations were made at Augusta, in Sicily. The other station occupied by the Italian astronomers was Terra Nova, at which place Professor Tacchini had general charge of the observations, assisted by numerous subor-

dinates. The spectra of the protuberances were observed by himself. Observations on the corona were made, in duplicate, by two assistants; and the observations of the times of contact made, again in duplicate, by two others. The drawings and photographs made by the Italian astronomers, as reproduced in the published volume, show the sun's limb to have been remarkably occupied by the familiar red protuberances, many of them nearly 100,000 miles high, and of strikingly characteristic forms. The corona is depicted as a mass of white light, projecting in spurs, of which ten or twelve are definitely presented, to a distance of at least 500,000 miles from the solar surface. In the spectrum of the corona, as observed in Augusta, two bright bands were observed, one in the yellow, the other in the green, corresponding nearly with spaces No. 1250 and No. 1465 of Fraunhofer's scale. Professor Legnazzi records the phenomena of Bailey's beads, and also observed a bright indentation in the edge of the moon, as if the solar light shone through a deep cleft in that body. A similar phenomenon was also recorded by Tacchini, from whose drawing of the appearance of Bailey's beads it may be at once seen that these are really only those portions of the solar limb last visible, and separated from each other by the intervening projecting mountain peaks on the edge of the moon. Accompanying the volume are very fine plates of the appearance of the protuberances as seen by means of the spectroscope, for some days before and after the eclipse in question, together with a magnificent delineation of the appearance of the sun, with its numerous spots, faculæ, and protuberances, as observed on the 10th of December; from all of which it would seem as if that month was one of special activity on the sun's surface.—*Report of the Italian Commission.*

THE APPARENT DIAMETER OF THE SUN.

Professor Mazzola contributes to the Royal Academy of Sciences of Turin an interesting paper on the determination of the mean diameter of the sun, and upon the numerous causes which introduce error into the observed diameter, and especially the so-called phenomena of irradiation. He shows that the solar diameter deduced from observations of the transit of an inferior planet over the solar disk ought to be

notably less than when determined by means of the sun's transit over the meridian. The large discordances between the numbers adopted by different astronomers to represent the solar diameter are due, as he concludes, both to irradiation proper, and to the persistency of luminous impressions, the nature of the retina being such that the image of any point upon it is subject to an expansion, or an increase in its diameter. As this irradiation would, therefore, affect the intensity of the brightness of minute points, he proceeds first to investigate that subject. The expansion is due, he concludes, to the deformation of the cone of rays, after passing the crystalline lens of the eye, and also to the imperfect adjustment of the eye for all distances, and, thirdly, to the ordinary phenomena of diffraction. To these must also be added the influence of the tremulous condition of the atmosphere, causing a general deviation of the light of the fixed stars. As regards the expansion of the image resulting from the imperfections of the eye, he has made a number of measurements upon the visibility of stars close together, and concludes from these that the mean diameter of the exaggeration caused by the human eye is about 3 minutes of arc, when the pupil has its maximum opening, and not less than 2 minutes when the pupil is contracted. These considerations serve to explain why the horns of Venus are invisible to the naked eye. In order to determine the enlargement produced by a telescope, he turns it upon certain double stars, and finds that the correction for the expansion is constant, and equal to the least opening of such binary systems as are resolvable with a given magnifying power. In respect to the atmospheric perturbations, he finds its effects to vary from between 4 to 15 seconds, depending upon the magnitude of the star. In applying his conclusions, drawn from the observations of fixed stars, to the case of the solar diameter, he concludes that the latter, as ordinarily accepted, is subject to a correction for irradiation of from nothing to 1.7″; to a constant correction for expansion of 2.3″; and to a correction for atmospheric expansion varying between 0 and 10″. In order to deduce the angular diameter of the sun at its mean distance from the earth, from an observation of its meridian transit, it is necessary to multiply 14.345 by the number of seconds contained in the apparent error of the duration of

the transit, as given by the British Nautical Almanac, and to subtract the product from 31′ 3.64″. Applying this rule to the observations published by the Royal Observatory of Greenwich for sixteen years (from 1853 to 1869), he deduces a series of results which lead him to investigate the question of the variability of the diameter of the sun; a problem that had been approximately resolved, a few months previous, by Fathers Secchi and Rosa. He finds, however, that the discordances in his results are plausibly attributed, not to a variability in the sun itself, but to the variability in the condition of the earth's atmosphere, and to the peculiarities of the eyes of different observers; and expresses his exact result in the following terms: The mean correction to the diameter of the English Nautical Almanac (32′ 3.64″) is −2.807″, with a probable error of 0.193″, when the number expressing the atmospheric enlargement is 2, and that expressing the ocular irradiation is 5. Applying his rules to seventy-five observations made by himself in 1872, for which the number on the scale expressing the atmospheric enlargement is 7, he finds the solar diameter referred to the mean distance of the earth to have a mean value of 31′ 57.3″, with a probable error not surpassing 1″; and asserts that he has every reason to believe that the diameter of the sun is notably less than that usually adopted by astronomers, and approximately equal to the number just given.—*Atti della R. Accad. Scienze, Turin*, 1873, Part VIII., p. 587.

THE SATELLITES OF JUPITER.

Professor Alexander, of Princeton, suggests that an explanation, better than the common ones, may be given of the peculiar phenomena exhibited by certain satellites of Jupiter, which, as they pass over the disk of the planet, become apparently much fainter, and even black, in comparison with the bright body of the planet. He thinks that the phenomena seems to be the result of the absorption and interference of the vibrations of light, on a scale such as only astronomy exhibits. He also concludes that the temperature of the surface of the obscure-looking satellites must be lower than that of the atmosphere, or at least of the body of the planet; and, finally, that the satellites which exhibit these very remarkable phenomena have no atmospheres, and are,

in this respect, like our moon.—*Astron. Nach.*, LXXXIII., 276.

THE MOON CONSIDERED AS A WORLD.

According to Mr. Nasmyth's recent work on the moon, the geological influences that have been operating upon its surface in past ages, to form the peculiar volcanic craters and other phenomena observed by astronomers, are essentially of the same nature as those that have also been operating upon the earth's surface. The observations made by Mr. Nasmyth during many years have enabled him to construct models of certain portions of the lunar surface, which, when placed with a strong light shining obliquely upon them, reproduce the ever-changing effects of light and shadow observed through the telescope. These models he has photographed, and thus produced the most perfect representations of lunar scenery ever yet published. Besides the craters, which are of such general interest, Messrs. Nasmyth and Carpenter have given special attention to the bright streaks radiating from certain regions of volcanic activity. More than a hundred such bright streaks radiate from the great crater Tycho, and these traverse plains, mountains, craters, and all asperities, holding their way totally regardless of every object that happens to lie in their course. Quite different from these "streaks" are the "cracks," some of which are easily seen, but most of those recorded by Messrs. Nasmyth and Carpenter are excessively delicate objects. The authors incline to the belief that the moon never had an atmosphere, properly so called, and maintain that the volcanic action of the moon depended, not upon the agency of gases, vapors, nor water, but upon a principle announced by them; namely, that most solids expand as, in cooling, they pass from the liquid to the solid form, and that this expansion of the material, which, at one time, was in a molten condition, caused the crust of the moon to occupy a larger volume than the original molten mass. Unable, however, by its weakness, to preserve itself intact, the crust cracked, and through these cracks the interior liquid was ejected. This theory has some points in common with that maintained by Mallet in explaining the phenomena of vulcanicity on the earth's surface, but differs essentially in that Mallet's theory requires the intervention

of water. Mr. Nasmyth long ago illustrated the bright streaks on the moon by the following striking experiment. A glass globe is filled with water, and, being hermetically sealed, is plunged into warm water. The inclosed water expanding at a greater rate than the glass, exerts a disruptive force on the interior surface of the latter, the consequence being that at the point of least resistance the globe is rent by a large number of cracks diverging in every direction from the focus of disruption, presenting an appearance strikingly similar to the rays that radiate from Tycho.—12 *A*, 1873, IX., 358.

ROTATION OF THE PLANETS.

Professor Peirce has attempted to deduce from the nebular hypothesis an explanation of the actual rotation of the planets on their axes; and reasoning especially with regard to Jupiter and Saturn, he shows that the inner portion of the ring thrown off from the rotating central body must have a less velocity than the outer portion, and consequently there must be a breaking up of the ring, and the formation of planetary bodies. He demonstrates by a mathematical analysis of the movements of the particles constituting the liquid ring that the velocity of the resulting rotation must be such as is actually observed.—*Pr. Nat. Acad., N. Y. Tribune, October*, 31, 1873.

NEWCOMB'S TABLES OF THE MOON.

With reference to Professor Newcomb's investigation of the moon's motion, the superintendent of the Naval Observatory reports that the work has been nearly accomplished and prepared for the press, according to the original plan; but on examining certain terms troublesome to calculate, which it was supposed were entirely unimportant, it was found that the work could not be properly completed without them. The preparations for observing the transit of Venus have interfered with the development of these important terms. The second part of the work (namely, the tables founded upon Professor Newcomb's theory) has been carried as far as it can be without the data that will be attainable as soon as the preparations for observing the transit of Venus are completed.—*Report Sec. Navy*, 1873.

DEFECTS IN THE LUNAR TABLES.

An important communication by the astronomer royal of England to the Royal Astronomical Society explains the existence of a serious defect in the present condition of the lunar theory. In 1827 Sir George B. Airy announced the discovery of a term depending on the relative motion of the earth and Venus, whose period was 239 years. The introduction of this term into the lunar tables of Professor Hansen was shown by Delaunay in 1863 to be unjustifiable, and Delaunay's results having been confirmed by the recent investigations of Professor Newcomb, Professor Airy, now admitting the possibility of an error in his earlier investigation, and the correctness of the results of Delaunay and Newcomb, has sought to ascertain what will be the effect of withdrawing from Hansen's tables of the moon the term in question. He finds that, after applying the best known value of the mean longitude and mean motion of the moon that can be obtained, there remains a series of large and systematic discordances quite beyond the limit of accidental errors. Furthermore, he has examined into the effect of assuming that these systematic discordances arise from an error in the secular mean motion of the moon. If we diminish the secular acceleration of the moon's mean motion so as to represent modern observations with sufficient accuracy, we diminish the tabular longitude of the moon by 160 seconds of arc in every thousand years, and the result of this would be to completely disarrange the calculation of the exact dates of certain ancient solar eclipses, which have been much relied upon in chronological investigations.—*Monthly Notices Roy. Astron. Soc.*, XXXIV., 1.

THE APPARENT DIAMETER OF THE MOON.

Neison has investigated the value of the apparent diameter of the moon, as given by occultations of stars. He finds that, from thirty-five observations of the disappearance of stars at the dark limb of the moon, the correction to the adopted semidiameter is $-1.7''$; and, from twenty observations of the reappearance of stars at the dark limb of the moon, the correction is $-0.36''$. On the other hand, eleven observations of the disappearance of stars at the bright limb

give a correction of $+1.81''$, and ten observations of the reappearance at the bright limb one of $+1.31''$. For the purpose of investigating the probable cause of these differences, Mr. Neison states that he is extending his calculations to a large number of observations. But, as a preliminary theoretical explanation of this difference, he submits a highly interesting and suggestive note on the existence of a lunar atmosphere of extreme tenuity; and shows that, if such an atmosphere exist, having a density, at the surface of the moon, of only $\frac{1}{400}$ part of the density of our own atmosphere, there would be at the dark limb of the moon a horizontal refraction of about one second, while at the bright limb the horizontal refraction would amount to less than half a second. These results he considers confirmatory of the idea that the difference between the occultation and telescopic diameters has its origin in the presence of a lunar atmosphere. He furthermore disposes of all the various more or less ill-founded objections that have been raised as to the existence of a lunar atmosphere, but without considering that he has yet been able actually to demonstrate its presence.—*Monthly Notices Roy. Astron. Soc.*, 1873, XXXIV., 6–16.

EXPLOSION OF A METEOR.

In the proceedings of the Royal Society of London for January 23, 1873, is an account of a meteor which burst against a British light-vessel not far from the Scilly Islands, scattering a shower of cinders on the deck, which were crushed under the feet of the sailors as they walked. Nothing was observed before the shock, but immediately after it balls of fire, like large stars, were seen falling into the water, resembling splendid fireworks. The seamen reported that there was a decided smell of brimstone, although it is thought this may have been imaginary. The cinders were, unfortunately, all washed off the deck by the rain and sea before daylight, so that no specimen was preserved.—*Pr. Roy. Soc. London*, 1873, XXI., 122.

THE CONSTITUTION OF COMETS.

Dr. Vogel has reviewed the results of the spectrum analysis of the light of the comets that have appeared since 1864. None of these have been remarkable for their brilliancy, and

in most of them the difficulty of attaining exact measurements has been almost insurmountable, because of the faintness of the objects. The spectrum of the second comet of 1868 seemed to Huggins to give with some certainty a coincidence of the three bright bands with the three bands of olefiant gas, and it has been somewhat rashly inferred that the hydrocarbons were generally present in the cometary substance. This opinion, however, Vogel combats with considerable force, showing that of nine comets examined within ten years there is as yet only one for which two reliable observers agreed in asserting a probability of coincidence of the lines in its spectrum with those of hydrocarbons; and Vogel thinks we should content ourselves with the deduction that a portion of the light is emitted by the comet itself, very probably from glowing gas, the remainder being that which is reflected from the comet's surface. In regard to the various statements that nitrogen, aqueous vapor, and other bodies have been identified in these comets, they can not be accepted as firmly established. These are merely hypotheses that should have a stimulating influence on the progress of scientific research.—12 *A*, IX., 193.

ORIGIN OF AURORAS.

Mr. E. B. Elliott, of the Bureau of Statistics at Washington, advances the theory that the exhibitions of brilliant and marked auroras are connected with the rate at which the earth approaches to or recedes from the sun.—*Pr. Am. Assoc.*, 1873.

VOSTOKOFF ON OLBERS'S METHOD OF DETERMINING THE PARABOLIC ORBITS OF COMETS.

A young Russian astronomer, Vostokoff, already known in his own country by several works in theoretical astronomy, and who is professor of this department in the University of Warsaw, has lately published a memoir on the determination of the parabolic orbits of comets, in which he introduces several modifications of the method published by Olbers. The formulæ, as arranged by Vostokoff, have apparently a very considerable degree of convenience, and he has applied them, by way of example, to the second comet of 1813, and also to the first comet of 1871. The peculiarity of his

method appears to consist especially in the convenient form into which he throws the work of solving that portion of the computation called the solution of Lambert's equations; and the method, as elaborated by him, appears to be well worthy of the consideration of those engaged in such calculations.—*Vostokoff, Warsaw*, 1873.

THE OBSERVATION OF AURORAS.

It has been suggested by Heis, the editor of the *Wochenschrift*, that it is highly advisable for meteorological observers throughout the world to arrive at a more precise and systematic method of observing the Northern Lights. He remarks that it is most desirable to have accurate drawings of the appearance of the aurora, together, of course, with estimates or measures of all its dimensions, made at the beginning of each hour, and, if possible, at the beginning also of each quarter-hour, and that the European observers might uniformly adopt Berlin mean time, in order that the several drawings and estimates may all refer to the same moment. Such simultaneous observations have a very great advantage over those taken according to local time, and offer no difficulty whatever, inasmuch as every observer, knowing his longitude, and having his clock well regulated, may easily select the exact minute corresponding to the quarter-hours at Berlin.

It is evident that this same suggestion carried out for America will add immensely to the value of the almost innumerable records that are now being received, not only by the government officials at Washington, but by the societies scattered throughout the country. In order to further this system of synchronous observation, which ought to extend throughout the whole world, since many auroras are simultaneously visible in both hemispheres, we note that the longitude of Washington from Berlin is six hours one minute and forty-eight seconds; and with this as a starting-point, it becomes possible for American observers to time their observations by Berlin time. While these remarks apply especially to the auroras that continue for several hours, and extend over a large section of the heavens, they are not the less applicable to those small auroral displays, and especially to the narrow auroral arches, that so frequently span the heavens

from east to west, from northeast to southwest, or from southeast to northwest.— *Wochenschrift*, 1873, 290.

NATURE OF THE AURORA.

In the valuable memoir of the lamented Donati on the great aurora of February 4, 1872, there is given a brief synopsis of the views of various physicists on the nature of this phenomenon, from which we quote the following:

Des Cartes considered the aurora as a meteor falling from the upper regions of the atmosphere. Halley attributed it to the magnetism of the terrestrial globe, and Dalton agreed with this opinion. Coates supposed that the aurora was derived from the fermentation of matter emanating from the earth. Mairan held it to be a consequence of a contact between the bright atmosphere of the sun and the atmosphere of our planet. Euler imagined the aurora to proceed from the vibrations of the ether among the particles of the terrestrial atmosphere. Canton and Franklin considered the aurora as a purely electrical phenomenon. Parrot attributed the aurora to the conflagration of carbureted hydrogen, escaping from the earth in consequence of the putrefaction of vegetable substances, and considered the shooting-stars as the initial cause of such conflagration. Oersted and De la Rive considered the aurora as an electro-magnetic phenomenon, but purely terrestrial. Olmsted suspected that a certain nebulous body revolved around the sun in a certain time, and that when this body came into the neighborhood of the earth a part of its gaseous material mixed with our atmosphere, and that this was the origin of the phenomenon of the aurora. The author having considered the appearance of the great aurora of the 4th and 5th of February, 1872, as a fit occasion to arrive at some correct conclusion in regard to the aurora, and having, by means of circular letters, received from all parts of the world a mass of valuable material, concludes from the study of these observations that the luminous phenomenon of the great aurora was observed over a vast extent of the earth during the night of the 4th and 5th of February, 1872. It was seen first in the East, in China, and then successively in countries to the westward, until it was finally seen in America. These manifestations were not simultaneous at all points of the earth, but there was a tendency to antici-

pate in proportion as it was propagated from the east to the west.—*Donati on the Aurora of February* 4, 1872.

THE POLARIZATION OF THE ZODIACAL LIGHT.

The difficulty of obtaining satisfactory observations in the delicate question of the polarization of zodiacal light has been at length successfully overcome by Professor Wright, of Yale College. He states that numerous attempts had been made by him to detect appearances of polarization with the ordinary Savart polariscope, but never with any result except on one favorable occasion, when, by the utmost exertion of visual effort, the bands indicating the presence of polarized light seemed to be visible by glimpses. The observation was so uncertain, however, that it was considered worthless. Success in this matter crowned Professor Wright's labors only after he had, perhaps accidentally, found among the apparatus belonging to the physical cabinet of Yale College a quartz plate, which was cut perpendicularly to the axis, and exhibited by polarized light an unusual intensity of color. This plate consisted, essentially, of left-handed quartz, through which passed, somewhat eccentrically, a narrow band of right-handed quartz. This band was not bounded by sharp lines of division, but by intermediate and still narrower strips, which were of different structure, and apparently formed by the interleaving of the strata of the two portions at their edges. In the polarizing apparatus these strips simply vary from bright to dark, without marked appearance of color. Examined with one Nichols prism and unpolarized light, the plate appears perfectly colorless, and shows no trace of its heterogeneous nature. In order to adapt this quartz plate to the observation of the zodiacal light, it was placed in one end of a tube about eleven inches long, at the other end of which was placed a Nichols prism, the latter being easily turned upon its axis. Thus mounted, it formed a polariscope of extraordinary sensibility, far excelling the best Savart, when faint lines were to be examined. The narrow strips are peculiarly advantageous, as, with a very feeble illumination, they appear bright upon a dark ground, or the reverse, and are thus easily seen. As a test of its delicacy, it is mentioned that when a glass plate is laid upon the window-sill, and the diffused light of the sky in a clear moon-

less night, after reflection from it, is viewed through the instrument, both bright and dark bands are easily seen. This delicate instrument never failed to indicate the existence of polarized light in the zodiacal light; and Professor Wright sums up his comparative observations on the polarization of this light, and that from terrestrial substances, by stating that the zodiacal light is polarized in a plane passing through the sun. The amount of polarization is, with a high degree of probability, as much as fifteen per cent.; but can hardly be as much as twenty per cent. The spectrum of the light is not perceptibly different from that of the sun, except in intensity. The light is derived from the sun, and is reflected from solid matter. This solid matter consists of small meteoroids revolving about the sun, in orbits crowded together toward the ecliptic.—4 *D*, 1874, VII., 451.

TELEGRAPHIC STANDARD TIME.

The telegraphic apparatus at the Naval Observatory at Washington is now connected with the main lines of the Western Union Telegraph Company, so that not only is the time-ball dropped daily at noon, but the same signal is widely distributed by the telegraph company. It goes directly from the observatory to the main office in New York City, and thence it is sent to nearly every state in the Union. The immediate object of these signals is to furnish accurate and uniform time to the railroads, and, throughout the whole of the vast territory in question, there is scarcely a train whose movements are not regulated by the clocks of the observatories at Washington, Pittsburgh, Cambridge, Albany, or Chicago. The clocks at the Navy Department, at the Army Signal-office, at the Treasury Department, and at the Western Union Telegraph Company's office are all constructed on the system known as Hamblett's, and are directly controlled by electric currents sent every second by the standard clock at the Naval Observatory.—*Report Sec. Navy*, 1873.

PROPOSED ENDOWMENT OF AN OBSERVATORY IN MINNESOTA.

A novelty in legislation consists in the recent introduction into Congress of a bill proposing to grant the State of Minnesota 200,000 acres of land within its limits, the proceeds of which shall be kept as a perpetual fund, the interest to be

applied to the support, maintenance, and equipment of an astronomical observatory and school of mines, at St. Anthony's Falls, in connection with the Minnesota State University. A special stipulation in this proposed act is that the schools shall be free of charge to all students.

PROPOSED OBSERVATORY IN CALIFORNIA.

For some years past much interest has been exhibited in the United States in reference to the erection of a large telescope, and possibly a complete astronomical observatory, on the high portion of the Rocky Mountains. As preliminary to this, a number of careful examinations have been made of the optical qualities of the atmosphere in various portions of the Western country. Of these, special interest attaches to the expedition of Professor Davidson of the Coast Survey, whose report to the California Academy of Sciences states that the meteorological tables kept at Summit Station, on the Sierra Nevada, 7042 feet above the sea, during the year ending November, 1867, show that out of 358 days and nights only eighty-eight were cloudy, nearly all of these occurring in the winter months, during which the snow-fall was about forty-five feet, the winter not being unusually mild. The summer weather is very pleasant, the nights cool, and the atmosphere wonderfully clear. The mountain flanks are covered with verdure during the summer, which insure freedom from great clouds of dust. Professor Davidson says that, owing to the steadiness of the atmosphere, observations at this elevated point in one or two nights would be of greater value than the results of six months' observations at lower stations. Higher and perhaps more desirable positions exist in the immediate neighborhood of Summit Station; and the interest excited by Davidson's report probably has, to a considerable extent, influenced the determination announced in a recent letter of Mr. James Lick, the well-known millionaire of San Francisco. This gentleman has indicated in a letter to the California Academy of Sciences, and again in a letter to Professor Joseph Henry, his desire to establish an observatory in the best possible location, and provide it with the largest and finest astronomical instruments. He proposes to this end to set aside one million dollars as a permanent endowment fund. This is a monument and a renown which few are rich and

wise enough to achieve for themselves, and it is greatly to be hoped that the founder of Lick Observatory may live to enjoy the congratulations of his state and country.—*Overland Monthly*, 1873, 556.

THE NEW OXFORD OBSERVATORY.

Mr. De la Rue having in the course of last summer made a munificent offer of several instruments, including a large reflecting telescope and the almost entire outfit of his own private observatory, to the University of Oxford, the subject was at once brought under the consideration of the museum committee, which has unanimously agreed to accept the offer of the distinguished amateur astronomer. The building for the proper erection of the instruments is ordered to be erected in the park of the university museum, and to the same building will also be brought the instruments now in the small observatory on the east side of the building. Provision is made for the regular use of the instruments of the new Oxford Observatory by granting authority to the Savilian Professor of Astronomy to secure, at the rate of £200 per annum, an assistant for five years, who shall make such observations as he may judge proper. It is probable that the new observatory thus established will render special service to astronomy in the departments of photography, spectroscopy, photometry, etc., as contrasted with the labors carried on at the Radcliff Observatory, which are, and have been, especially confined to the use of meridional instruments and measurements of precision.—12 *A*, IX., 52.

THE NEW OBSERVATORY OF QUITO.

Astronomers will be interested to learn that among the numerous able men whom the President of the republic of Ecuador has gathered to that city in order to develop the University of Quito, there has appeared one, Father Menten, whose interest in astronomy has been such as promises to settle the long-mooted question as to an observatory in that city. Menten has now returned to Quito laden with a portion of the instrumental outfit that he was ordered to secure at Munich. Among the apparatus is a good meridian circle. Father Menten was for some time a pupil of the eminent Argelander.—*Heis, Wochenschrift, December*, 1873.

THE CORDOBA OBSERVATORY.

Dr. Gould, the director of the new observatory in the Argentine Confederacy, continues to send encouraging accounts of the progress of the great astronomical works that he has there undertaken. Having labored to determine accurately the relative brightness of all the stars in the southern heavens visible to the naked eye, he announces that a few weeks will enable him to begin the preparation of this work for publication. Great care has been taken to make a thorough and accurate comparison of the results of the four assistants, and the rule has been to determine the brightness of all the stars down to the 7.3 magnitude, in order to make sure of losing none as bright as the seventh. The labor on the Uranometry was undertaken before the arrival of the large meridian instrument, and as soon as the latter was established (namely, on the 9th of September, 1872), the observations of the zones of all stars as bright as the ninth magnitude were commenced in earnest. Each night three zones are observed, whose lengths average about one hundred minutes, the entire observations for the night occupying at least eight hours. The weather is described as having been exceedingly unfavorable for astronomical work during the winter and early spring, until March, April, and May of 1873, when magnificent opportunities were enjoyed. Dr. Gould states that he has observed in all during the past year about fifty thousand stars, and considers that somewhat more than half of the work of observing is already finished. Astronomers, however, know how great a labor of computation still awaits Dr. Gould and his assistants before his results can be put into that form which is most convenient for use. The photographic work undertaken by him at his own private expense has been prosecuted with all the success that could be expected with a broken lens. Finally, however, he concluded to order another object-glass for the use of the observatory; and the new lens having arrived in perfect order, he hopes before long to be able to resume his labors under better auspices.

The Cordoba Meteorological Bureau, established at his urgent representation by the national government, has been organized and brought into working condition as rapidly as was practicable; but as the instruments were necessarily

ordered from foreign countries, not more than half of them had arrived at the latest advices. Dr. Gould has, however, had the gratification of finding two gentlemen who have each carried on an uninterrupted series of observations for some dozen years past—one in Buenos Ayres, and the other near the Patagonian frontier—and he has secured the co-operation of about fifteen correspondents. The programme issued for the instruction of his observers differs apparently but little from that of the Smithsonian Institution, the hours of observation being seven, two, and nine, local time.—4 *D*, 1873, II., 355.

ASTRONOMY IN THE ARGENTINE CONFEDERACY.

From the third annual report of Dr. B. A. Gould, director of the National Observatory of the Argentine Republic, as presented on the 31st of January, 1874, we gather the following items. The observation of zones of southern stars has continued with unabated activity up to the present time. The observations have been fully completed over that portion of the heavens situated between 18 and 6½ hours of right ascension, and between 23° and 80° of south declination. Those parts of the sky which remain to be examined are among the richest in stars. It is estimated that they will require at least 115 additional zones, and contain not less than 15,000 stars; thus the complete work will probably fall but little short of 85,000 observations, corresponding to about 65,000 stars. A special catalogue of well-determined stars is also in progress of execution, for which at present about 4000 observations, on nearly 1700 stars, are available. These will form the fundamental stars for the reduction of the zones, and also for the completion of the uranometry. With the exception of about five weeks in October and November, the equatorial was used for photographic work. During the interval alluded to, at the suggestion of Dr. Galle, this instrument was employed in observations of the planet Flora, in co-operation with other observatories, in order to contribute somewhat to the determination of the parallax of the sun. The observatories of Melbourne and the Cape of Good Hope also carried out a similar course of observations. Awaiting the publication of the uranometry, considerable attention has been given to a revision of some portions of that work, thereby much increasing its ultimate value. The organiza-

tion of the Meteorological Office has been intrusted to Dr. Gould as an additional temporary labor; but it is contemplated that the complete control of the Meteorological Office will soon be placed in the hands of another person. The labor of carrying out the computations of all kinds is estimated by Dr. Gould to require four or five hours of office-work for every hour spent in observation, and has apparently been prosecuted with much zeal, notwithstanding the interruption which existed during a portion of the year, occasioned by the departure of two assistants and the arrival of their successors. A list of fifty-four circumpolar stars used for determining instrumental azimuth has been prepared, and a proper ephemeris computed therefrom. The measurements, the reading of the chronograph sheets, and general computations upon the zone observations, have been recently éntered upon. The differences of longitude of four places have been determined—Rosario, Buenos Ayres, Rio Cuarto, and Mendoza; and of still more importance has been the accurate determination of the difference between Cordova and Santiago. Time-signals for regulating the clocks on various lines of telegraph have been sent regularly once a week. The photographic lens designed to replace that which was first furnished, but was broken in transit, was received in the month of June. It thus appears that, notwithstanding numerous annoyances which are mentioned in more or less detail in Dr. Gould's report, and which are well known to the astronomers of the world who have read his special letters thereupon, he has, with characteristic energy, actively pushed on the great labor that he had undertaken, and whose ultimate success is the earnest wish of numerous friends.—*Buenos Ayres Weekly Standard, February* 25, 1874.

YOUNG'S THEORY OF THE SUN'S CRUST.

Professor Young has put forth a very novel theory as regards the construction of the exterior of the sun. He says there can be but little doubt that Faye, Secchi, and others, who hold that the sun is mainly gaseous, are correct; while, at the same time, the phenomena of eruption which are always occurring on the surface as shown by the telescope establish the idea that there is a crust of some kind which restrains the imprisoned gases. Professor Young states that this crust

may consist of a more or less continuous sheet of descending rain—not of water, of course, but of the materials whose vapors are known to exist in the solar atmosphere. As this tremendous rain descends, the velocity of all the falling drops would be retarded by the resistance of the denser gases underneath, and the drops would eventually coalesce until a continuous sheet would result, and several of these sheets uniting, would form a sort of bottomless ocean, resting upon the compressed vapors below, and pierced by innumerable jets and bubbles.—*N. Y. Tribune, October* 31, 1873; *Proc. National Academy.*

THE ATMOSPHERE OF JUPITER.

Dr. Lohse has investigated the velocity of the rotation of the cloud layers of Jupiter at different degrees of latitude on that planet. He finds that, in general, in the middle latitudes of Jupiter, there is a greater stability in the upper strata of the atmosphere than in the neighborhood of the equator, where the velocity of the rotating masses is increased by wind. He sees in this fact a probability that trade-winds prevail there as upon our earth.—7 *C*, X., 185.

VISIBILITY OF THE DARK HALF OF VENUS.

The fact that, occasionally, the dark half of the surface of the planet Venus glimmers with a peculiar gray light is one of the most interesting phenomena that is noted in connection with the planets of our system. The records of the numerous cases in which this phenomenon has been observed have been collated by Dr. Safarik, from which it appears that twenty-one different observers, and twelve of these more than once, have noticed the phenomenon in question. More than half of these observations belong to the last twelve years, and he concludes that probably the phenomenon is one of constant occurrence; that, indeed, it is the normal condition of the planet, and can be seen at every inferior conjunction, if only the planet be carefully watched, and with sufficiently powerful telescopes. The earliest observation of those collected by him is that made by Derham about the year 1712. Bode, Meyer, William Herschel, and Schroeter are among those who recorded this phenomenon in the last century. The latest observations are those by Winnecke and

Klein, in 1871. The latter states that, among the various and sometimes fanciful theories that have been devised to explain this phenomenon, Safarik omits to enumerate that which seems to him most likely to be the true one: namely, the possibility that the illumination of the dark half of Venus is effected by means of the light reflected from a satellite to that planet. This theory has been especially developed by Klein in his work on descriptive astronomy, in which he also explains why the secondary illumination of Venus is so seldom visible in the great telescopes, and why the question whether Venus possess a moon must still remain an open one. —7 *C*,1874,154.

THE SOLAR ECLIPSE OF 1874.

The observations of the total eclipse of the 16th of April, 1874, have been successfully carried out by Mr. Stone, director of the observatory at the Cape of Good Hope. He noticed that the coronal atmosphere was apparently, as might have been expected at this period of minimum sun-spots, smaller than in 1871, while the clearness of the air at his station reduced the phenomena peculiar to the earth's atmosphere to a minimum. The spectrum of the reversing layer was again seen, thus confirming Young's observation of 1870. Perhaps the most important observation made by Mr. Stone is that referring to the visibility of the Fraunhofer lines in the spectrum of the coronal atmosphere, showing thereby that the latter reflects the light of the photosphere.—7 *C*, 1874, 60.

ANCIENT SUN-DIALS.

A visit to Pompeii, as also a visit to the Museum of Pompeian Antiquities at Naples, brings to notice a great number of sun-dials, which are sometimes ornamented very beautifully. As the division of the day into hours was in Roman times very different from that at present in use, since they divided the day, from sunrise to sunset, into twelve equal parts, the hours being therefore of varying length, it follows that their sun-dials must have had a very different construction from our own. The face of their ancient dials is a concave spherical surface, worked in a stone, and set to face the south. A metal pencil is fastened on the upper side of the block of marble, so that its point is precisely in the centre of the

sphere. The shadow of this point falls upon lines cut into the concave spherical surface, and shows the hour of the day. Three circles are so drawn as to indicate the path described by the shadow of the pencil-point at the time of the equinoxes and solstices.

The conical sun-dial is another form known to have been used by the ancient Greeks, but no description of it has been preserved in their scientific literature. Lately, however, a complete copy of such a dial has been discovered. It consists of a marble block about two inches thick, whose upper and lower surfaces are horizontal, but one of whose side surfaces is so cut that it is parallel to the equator, and is itself turned toward the north pole. The inner surface of a right cone is worked into the marble block so that its base stands on the inclined side surface. Its axis is therefore parallel to the earth's axis. The angle at the vertex of the cone is equal to the latitude of the place. — *Heis' Wochenschrift*, 1874, 150.

SCIENTIFIC BALLOONING.

In a balloon ascent recently made for scientific purposes by Messrs. Croce-Spinelli and Sivel, the authors ascended to a height of about 22,000 feet, experiencing a temperature at that elevation of —7.6 Fahr. Spectroscopic and physiological observations were particularly attended to. It was noted that of the two obscure bands on the right and left hand of the double line D in the solar spectrum, the right-hand band disappeared at an elevation of about 16,000 feet, while the left-hand band vanished at about 21,000 feet, thus confirming Janssen's opinion that these bands are of terrestrial origin. The observers carried with them cans of condensed oxygen, and found some relief from the effect of the rarefaction of the air by breathing that gas.

CHANGES IN THE NEBULA AROUND ETA ARGUS.

The latest communication in reference to the changes of the nebula surrounding *Eta Argus* is by Mr. Abbott of Hobart-Town, Van Diemen's Land, in which he states that the small stars adjacent to the principal star, though agreeing very closely with drawings made a few years ago, have but little agreement with drawings made in 1836. A very consid-

erable increase in the number of stars has lately taken place, and there are now visible 170, as compared with 134 visible a year since. The boundary of the dark space within the nebula has now six openings, but is gradually becoming less distinct.—*Monthly Notices Roy. Soc. Tasmania*, 1872, p. 27.

THE ORBIT OF A BRIGHT METEOR.

Professor Galle, in the course of an investigation of the path pursued by a bright meteor, on the 17th of June, 1873, takes occasion to develop with great thoroughness the mathematical formulæ appropriate to such studies, in the use of which, in preference to any graphical construction, he seems justified by the unusually large number of accurate observations of this meteor. A singular observation of the beginning of the visible path of the meteor in question—an observation that was, in fact, of rare accuracy—was made by Mr. Sage, the principal of a high-school, who, happening to be looking at the planet Mars, saw it, apparently, break in two, and the next moment perceived that a meteor had come into view directly between himself and Mars. For a short time the meteor appeared to him without movement, and then slowly passed to the westward. In Galle's computations, he deduces as the orbit of the meteor a hyperbola having the sun in its focus, and scarcely appreciably inclined to the earth's orbit.—*Astronomische Nachrichten*, vol. lxxxiii., p. 320.

THE FLATTENING OF THE PLANET MARS.

Reverting to the proposition laid down by mathematicians, that the flattening of a liquid planet revolving on its axis must be contained within the limits $\frac{1}{2}$ and $\frac{5}{4}$ of the ratio between the attraction of the planet and the centrifugal force, and considering further that the planet Mars has a flattening quite in excess of $\frac{5}{4}$, Amigues has proposed to inquire into the question—What would be its flattening under the supposition that this planet has been formed, as we may say, by two successive operations? At first, according to him, a solid nucleus must have resulted from the cooling of a previous liquid mass; and, at the second step, by some means not suggested by him, we must imagine a mass of cosmical matter passing in the neighborhood of the planet to have been attracted by it to itself permanently, and to have formed

a thick liquid layer over the exterior of the solid nucleus. If, now, this exterior layer had, on the average, a density of 1.54 times the density of the nucleus, we should be able to explain the large flattening observed at present on the planet Mars.—*Comptes Rendus*, tom. lxxviii., p. 1557.

NATURE OF THE SUN'S SPOTS.

To the question of the nature of the solar spots, Professor Sporer has contributed somewhat, by applying to the observations quoted by Faye in support of his theory the very method of investigation suggested by the latter. While Faye defends the idea that the spots are deeper than the solar surface, Professor Sporer shows very satisfactorily that they are, on the contrary, above the surface, and must be considered as cloud-like objects.—*Heis' Wochenschrift*, 1874, p. 160.

HERSCHEL'S OBSERVATIONS OF THE SATELLITES OF URANUS.

As is well known, Sir William Herschel in the early part of this century concluded, from the numerous observations that he had made upon the planet Uranus, that it was attended by six satellites. Since his day no one, not even his son, Sir John Herschel, using the same telescope, has been able to perceive more than two of these six satellites, until it was reserved for Lassell, in 1845, to discover two others which were much nearer to the planet. The two interior satellites discovered by Lassell were, however, evidently entirely different from the two inner satellites claimed by Herschel. The study of Uranus that has recently been made at Washington, by means of the twenty-six-inch Clark refractor, has also failed to show the existence of any of the four missing Herschelian satellites; while the four observed by Lassell have been very frequently seen, and their position accurately observed. Professor Holden, of the observatory, has undertaken to discuss the interesting question as to whether the elder Herschel did not actually observe the two inner satellites of Lassell; namely, Ariel and Umbriel. By careful computations backward, based upon the result of Newcomb's observations, Professor Holden is led to the conclusion that it is certain that Herschel saw Ariel in 1798, and that he probably saw it in 1790. It is also certain

that he saw Umbriel in 1801, that he probably saw it in 1793, and may possibly have seen it in 1790 and 1794. It is thus evident that Ariel and Umbriel were truly discovered by Herschel, but that he was unfortunately prevented from identifying them by the fact that his telescope could never show them on two successive nights.—*Bull. Phil. Society of Washington*, 1874.

SOLAR SPOTS AND FACULÆ.

Bredichin, from some observations made in the neighborhood of Moscow, and at the observatory of that city, concludes that the theory of ascending and descending currents is sufficient to explain the formation and development of solar faculæ and spots. If on any portion of the solar surface an increase of temperature takes place, there must at that place soon be an ascending current. The head of this ascending current will form a cloud as soon as it reaches a proper height. The lower portions of the chromosphere flow from all directions toward the base of this column of ascending air. Subsequently, they ascend above the solar surface, and flow off to one side, and thus continue the circulation.—19 *C*, 1874, 194.

PROFESSOR YOUNG'S VIEWS OF THE CONSTITUTION OF THE SUN.

Professor Young states that he is disposed to accept a very simple view of the constitution of the solar atmosphere. He assents to the views of Zöllner as to the existence of a crust, either solid or liquid, through which, from time to time, masses of incandescent hydrogen burst out. Over this crust lies the atmosphere, composed of vapors and gases, each arranging itself, as if it were the only one in existence, according to the views of Dalton on the diffusion of gases and vapors. All the gases are therefore contained in a state of intimate mixture in a certain lower atmosphere, probably less than five hundred miles in thickness, immediately above the surface of the sun,—this is the birthplace of the Fraunhofer lines, and he supposes himself to have obtained a glimpse of it during the eclipse of 1870, at the moment when totality began. Ascending, we successively pass the limits above which the different gases do not rise, these limits being low-

est for the vapors of greatest density, highest for the hydrogen; and far above these towers the matter of the corona. The upper surface of the chromosphere has a form as irregular and fantastic as a sheet of flame, and it is probable that the wild commotion that exists within it is accompanied by a development of electric force abundantly sufficient to account for all the observed resemblances between the corona and the electrical phenomena of our atmosphere.—*Report of the Superintendent of the Coast Survey*, 1870, p. 115.

ABSORPTION SPECTRA AT LOW TEMPERATURES.

Roscoe has made some observations looking to the determination of the peculiarities of the absorption spectra of potassium and sodium at low temperatures. By means of a large Steinheil spectroscope, he detected in the green vapor given off by potassium a complicated absorption spectrum of three bands in the red and yellow, each shading off toward the red, and in general resembling those of iodine. Similarly, the vapor of sodium, which when seen in thin layers appears nearly colorless, exhibited absorption bands in the blue, red, yellow, and orange, each shading off toward the red, as in the potassium bands before noticed.—12 *A*, X., 1874, 136.

NEW METALLIC ELEMENTS IN THE SOLAR ATMOSPHERE.

Lockyer, in a preliminary report on the elements that have been found in the solar atmosphere, has shown that besides the zinc and aluminum rediscovered by Thalen, it is also probable that strontium, cadmium, copper, and cerium exist therein. If, now, it appears that cerium and uranium are really present there, it would follow that the entire group of "iron metals" occurs in the solar atmosphere.—*Heis' Wochenschrift*, 1874, 150.

A STRIKING SUN-DIAL.

A sun-dial that strikes the hours has lately been invented and constructed by the Abbé Allegret. It is simply a modification of what is known as the solar counter for registering the times at which the sun shines or is obscured. To effect this there are two balls, one black and the other yellow, fixed at opposite ends of a lever, sustained by a central pivot. When the sun shines, the black ball absorbs more heat than

the yellow one, and the vapor of a liquid contained in the former is elevated to a higher temperature than in the latter. As the result, the vapor leaves the one ball, and being condensed in the other, this becomes the heavier, disturbs the equilibrium of the system, and in so doing liberates a weight, giving motion to a clock-work attachment. In the sun-dial here referred to a pair of these balls is fixed at every hour-mark. When the shadow of the gnomon reaches any particular hour-mark one of the balls is shaded, a preponderance of liquid enters the ball, the lever tilts, the mechanism is set going, and a gong sounded as often as the number of the hour to be indicated. It is necessary, however, that the sun should shine when the hour-mark is being passed by the shadow, or the time will not be struck.

B. TERRESTRIAL PHYSICS AND METEOROLOGY.

THE EARTHQUAKES IN NORTH CAROLINA.

Professor Warren Dupré, of Spartanburg, South Carolina, communicates to the *Orphans' Friend*, published at that place, some interesting details gathered by him in relation to the recent earthquake phenomena in the neighborhood of Bald, Stone, and Round mountains, in North Carolina. He states that, in company with other persons accustomed to accurate observation, he examined this region in the latter part of March. The mountains in question are three peaks of a ridge extending ten miles, in a direction northeast to southwest, averaging over 3000 feet high, and which is one of the ridges that flank the Blue Ridge proper. Geologically considered, this ridge consists of granite slates without any evidence of volcanic rocks, and is covered every where with a dark rich soil and a growth of heavy timber. Professor Dupré states that from fifty to seventy-five shocks occurred between the 10th of February and the 20th of March. In almost every case the noise that was heard was simultaneous with the shock that was felt. The latter seemed to follow the direction of the rumbling sound with which the noise of the explosion usually ended. Certain days were marked by loud reports and severe shakes. Those living on the top of this ridge assert that the shocks appeared to be all under and around them: those living at a distance from it uniformly point to the ridge as the region from which the sounds and shocks appeared to come. The noises occurred as often in the night as during the day, in fair weather as in foul, and the shakes were felt to a distance of five miles on each side of the mountain ridge, and as far as twenty-five miles northeast and southwest of it. This testimony was collected from thirty or forty persons, whose uniform concurrence places the facts beyond the possibility of doubt. The shakes were frequently so severe that stout log-houses shook alarmingly.

On the 19th of March Professor Dupré's party had the pleasure of experiencing one of these earthquakes, and it is described by them as a loud explosion, followed by a low re-

verberating sound; no shocks being noticed by those traveling in buggies, although those standing on the ground felt it tremble under them. The hypothesis that these noises were caused by the blasting of rocks is held by Professor Dupré to be entirely unsatisfactory. No blasting, as far as he could learn, had taken place within a considerable distance of that neighborhood for many months past, and the observation that the sounds and shocks were nearly simultaneous, wherever observed, is inconsistent with the phenomena of blasting. He is inclined to believe that most of the noises accompanying earthquakes are the secondary effects of a force acting at a great depth, and concludes that the phenomena connected with the agitation of Stone Mountain must be referred to that general volcanic or earthquake force which has its origin deep down in the earth's crust. He sees no evidence of any volcanic action properly so called—neither in the immediate region of this mountain nor in the neighboring portions of the Blue Ridge.—*The Orphans' Friend, April* 4, 1874.

EARTHQUAKES IN NEW ENGLAND.

Mr. Lancaster, in some remarks on Mr. Brigham's catalogue of New England earthquakes, states that during the last three centuries the number of recorded earthquakes in New England has averaged about two per annum. The maximum numbers of earthquakes fall in February and November, the minimum in April and September. There are 168 recorded to have occurred during the entire period in the autumn and winter months, while only 86 are recorded in the spring and summer months.—12 *A*, IX., 332.

THE EARTHQUAKE OF MARCH 6, 1872.

An important contribution has been made to our knowledge of earthquake phenomena by the publication of a monograph, by Von Seebach, on the earthquake of Central Germany, on the 6th of March, 1872. The author states that, in this investigation, he intended to carry out the principles first fully developed by Mallet in his classic work on the great Neapolitan earthquake of 1857. On more carefully approaching the problem, however, and sifting the material at his command, it soon appeared that the application of Mallet's methods was scarcely practicable in the present case. As is well

known, Mallet has made special use of the direction in which the shock successively strikes each city or region affected by it, calculating both the angles of azimuth and emergence, so as eventually to demonstrate accurately the precise position, within the earth, of the region of disturbance whence the earthquake shock radiates in all directions. Von Seebach states that, in the case of the earthquake of 1872, it only appeared possible to rely principally on the exact determinations of the times at which the shock was felt in the various regions from which he has information. In order to obtain these data with the greatest certainty he applied to the Royal Telegraph Bureau, through which he received fifty-one reports of especially great value. The extreme limits between which definite information concerning the earthquake was received may be taken as being Berlin, on the north; Munich, on the south; Breslau, on the east; and Frankfort, on the west. The severest shocks were experienced in the region thirty miles south of Leipsic. A surface of nearly 50,000 square miles was thus affected by this phenomenon—a region which appears not very different in size from those corresponding to previous earthquakes, such as that of 1846 and 1855, in the same portion of the world. The earthquake was generally stated to have been felt as a kind of wave movement, advancing along on the earth. Many of the observers speak of two shocks, or, at least, of one prolonged shock, especially severe at its beginning and end. The permanent effects of the earthquake upon the earth and upon the water were but slight. As regards effects upon the atmosphere, opposing reports seem to have been received by Von Seebach. In numerous instances in which gusts of wind were observed in connection with the earthquake, he states that it is very unlikely that they should have had any real connection with that phenomenon. In only a very small region was the shock sufficiently severe to injure the mortar or stone of buildings, the severest being at Nuremberg. Numerous curious instances are recorded of the effects of the phenomenon upon the actions of animals, especially those in the Dresden Zoological Gardens; and some things appeared to show satisfactorily that animals perceived the approach of the earthquake a short time before it was noticed by men; the explanation of the fact being simply that such animals were conscious of

the vibrations of the earth when they were yet too feeble to be appreciated by the human race. In the more important element of the direction from which the shock was received, it appears, by entering these directions upon the map of the region in question, that there is scarcely any rule or regularity.

The most important part of Von Seebach's work consists in the development of the method of investigating earthquakes by simple observations of the exact moment at which the shocks are felt, a method whose importance was first shown by Schmidt, the director of the observatory at Athens, who, it is stated, deserves the credit of being the first—even before Hopkins and Mallet—to reduce the phenomena of earthquakes to exact calculations. After having determined the point on the earth's surface directly above the centre of concussion, Von Seebach shows that the mean true velocity of the earthquake shock was 24 English miles per minute, and the depth of the true origin of the shock probably was not less than $7\frac{3}{4}$ miles, and not more than $11\frac{2}{3}$ miles, and that, by reason of our want of better observations for the determination of these results, we must assume the depth to have been about 10 miles. Following the example of Mallet, the author attempts also to determine the form of the central cavity within which the explosion took place, and concludes that the cavity lay not far from the village of Amtgaren, ten miles under the surface of the earth, and was very probably a fissure which approximately stretched from N.N.W. to S.S.E., and possessed only slight horizontal dimensions. The fissure was not vertical, but inclined toward the E.N.E. within the earth's interior. — *Von Seebach, Mitteldeutsche Erdbeben.*

EARTHQUAKES IN THE CAUCASUS.

Moritz states that the city of Shamaka, in the Caucasus, is so frequently visited by earthquakes, and its inhabitants have so often experienced great visitations, that in that region the words Shamaka and earthquake are synonymous; and yet this is one of the most important and populous cities in the Caucasus. He has, therefore, thought it important to investigate the earthquakes occurring there, in order, if possible, to contribute something to seismic science.

He adduces numerous observations noted by himself, which, in many respects, conflict with the theories that are most commonly held; and, first, he maintains that the earthquakes of the Caucasus in general can not be attributed directly to volcanic action. As pictured by him, Shamaka stands at the mouth of the retort of the great natural manufactory of carbureted hydrogen, that in the eastern part of the Caucasus reveals its products to an, as yet, unknown extent. The chemical actions that are evidently going on within the interior of that portion of the earth afford, therefore, a sufficient explanation of the perpetual agitation that the earth experiences. He sees no reason to doubt that Shamaka and its neighborhood will, for the future as in the past, continue to be visited by frequent earthquakes; but advises the inhabitants not to remove, since it is possible, by the use of seismographs and telegraphic warnings, to so forewarn the people that no great loss of life need be apprehended. On the other hand, the legalizing of those laws for erecting buildings that seismology, in the hands of Mallet, has long since indicated, would, he thinks, materially diminish the destruction of public and private buildings. If we understand him correctly, there is but one house in the city that has been built upon the proper principles of safety, and this has, during the past twenty years, outlived every earthquake without the least trace of damage. The question of the proper location of a seismometer is treated by him with some fullness, and he very correctly points out that there are, in fact, but few observatories that enjoy so fortunate a combination of local circumstances as to make them appropriate places for the establishment of these instruments. From the details given by him of the direction of the shock of a number of earthquakes at Tiflis and at Shamaka, we gather that the mean direction of the shocks at Tiflis is from the north-northwest to the south-southeast; but that very frequent cases of refraction and reflection of the earthquake waves are experienced. Distinguishing between the direction of the shock and the direction of transmission of an earthquake, he finds that the latter occurs always in the direction of the southwest to the northeast. The difference between the direction of the shock and the direction of transmission of an earthquake is therefore, for that region, so variable and uncertain

that it would not be possible to predict either one of these elements by means of observations made only at one spot. In the Caucasus he finds that magnets have no loss of power before an earthquake, and hence can not be used as a means of warning.—*Shamaka and its Earthquakes, Tiflis*, 1872.

TERRESTRIAL MAGNETISM AND THE SHRINKING OF THE EARTH.

Mr. Howorth, in a short note, very suggestive in many other respects, speaking of the foci of upheaval and depression on the surface of the globe, states that we can not resist the conclusion that the earth is stretching itself in the direction of its shortest axis; that its periphery is being thrust out in the direction of the poles. Now as, on the whole, the earth is absolutely shrinking, and local uprisings are due to lateral pressure caused by a subsiding area, it becomes interesting to inquire what kind of a strain upon the earth would result in squeezing it out in the direction of the poles. The answer to this, in his opinion, must be that a strain is being applied in the way of a stricture about the world's equatorial region. This would, he thinks, also have another effect: it would induce magnetism in the earth, and that magnetism would have its poles in the regions of upheaval, as in fact they are. The magnetic poles are strictly, so far as our evidence goes, in the very foci of upheaval of the circumpolar regions.—12 *A*, 1874, IX., 202.

THE RATE OF CONTRACTION OF THE EARTH'S DIAMETER.

Mallet has recently made an interesting addition to his paper on volcanic energy, in attempting to calculate, on the basis of certain allowable suppositions, the amount, in volume, of the solid shell of our earth which must be crushed annually, in order to allow the shell to follow down after the more rapidly contracting nucleus. He shows that the amount of crushed and extruded rock necessary for the supply of heat for the support of existing volcanic action can be supplied by that extruded from a shell between six hundred and eight hundred miles thick, and that the volume of material, heated or molten, annually blown out from all existing volcanic cones, could be supplied by the extruded matter from a shell of between two hundred and four hundred miles in thickness. On data which seem tolerably re-

liable, the author has further been able to calculate, as he believes for the first time, the amount of annual contraction of our globe; and to show that, if that be assumed constant for the last 5000 years, it would amount to a little more than a reduction of about 3½ inches on the earth's mean radius. This quantity, mighty as are the effects it produces, is thus shown to be so small as to elude all direct astronomical observation; and, when viewed in reference to the increase of density due to refrigeration of the material of the shell, to be incapable of producing, during the last 2000 years, any sensible effect upon the length of the day. At the rate of contraction of 3½ inches in 5000 years, as above given, it would require about ninety millions of years to diminish the earth's radius by one mile; and, if there be any approximate truthfulness in these numbers, and in the number given by Mallet in his original memoir, for the entire contraction of the earth since it was a molten mass, the resulting figure expressing the age of the earth will be large enough to satisfy all the demands of the most extreme geological theories.—12 *A*, 1874, IX., 57.

THE DAILY VARIATION IN TERRESTRIAL MAGNETISM.

Wolf, on comparing the maxima and minima of solar spots with the magnetic observations made at Prague, concludes that both the range of daily variation of magnetic declination, and also the range of daily variation of horizontal intensity of the earth's magnetism, allow themselves to be very approximately represented by means of formulæ consisting of the sum of two terms, the first a constant and the second a variable, depending on the relative frequency of solar spots.—*Astron. Nach.*, LXXXIII., 290.

THE TIDES OF THE LAKE OF GENEVA.

A peculiar tidal phenomenon, known as the seiches, which has long been observed on the Lake of Geneva, forms the substance of an exhaustive investigation by Professor Forel, who adheres to the theory generally accepted in explanation of the phenomenon—namely, that it is due to variations of atmospheric pressure, the pressure diminishing at one part of the lake and increasing at another. The surface of the water rises in the former case, and sinks in the latter; thus a swing-

ing undulation is produced. Some of the larger seiches are attributed to earthquakes. The amplitude of the vibration varies in different seiches, and also in the same seiche from one part of the lake to another. The duration of a seiche is longer at Geneva than at Morges.—12 *A*, 1873, IX., 374.

THE FLUCTUATIONS OF THE LEVELS OF THE AMERICAN LAKES.

Dr. Dawson, geologist of the British North American Boundary Commission, has published a most remarkable comparison between the fluctuations in the heights of water in the American lakes and the frequency of the solar spots. He states that, having tabulated the better known fluctuations of the great lakes for a series of years, he found that these, when plotted out to scale, showed a series of well-marked undulations corresponding closely to the eleven-year period of sun-spot maxima. The first four maxima of sun spots (those previous to 1830), being separated by long intervals of years, with few spots, appear to have been closely followed by fluctuations in Lake Erie. The maximum of 1837, which was the year of greatest known intensity of the solar phenomena, was very marked in its effects on the lakes, giving rise, in 1838, to the highest recorded level of the waters in Erie, Ontario, and probably also in Superior. The last three periods of sun-spot maxima (those of 1848, 1859, and 1869) are so short, and the maxima so undecided, that the lakes appear to have been unable to follow them as closely as before. One period of high water is, to a considerable extent, merged in the next, resulting in a general high state of the lakes for the last thirty years; and, in fact, the fluctuations of the lakes seem to have been especially marked when the fluctuations of solar spots were also well marked. In passing from the chain of great lakes to the Lake of the Woods, Dr. Dawson finds that, although the data are slight, yet, at least in three cases, its fluctuations appear to have coincided with those of the great lakes. In explaining this remarkable connection, Dr. Dawson says that the great lakes, in their changes of mean yearly level, probably show a very correct average of the rain-fall and evaporation over a large area, thus indicating the relative amount of evaporation taking place in different seasons; and it is much to be desired that systematic observations should be made of the actual mean annual outflow.

Wolf has found, from an examination of the chronicles of Zurich, that in Switzerland the maximum of solar spots agrees with dry and fruitful years; while Gautier finds, from a more extended series of observations, an exactly opposite conclusion. It is quite possible, however, that both may be true—that, in reality, the result of greater solar energy might produce in one region a greater desiccation, while in another a greater precipitation followed.

The correspondence between the fluctuations of the lakes and the solar spots seems to be sufficiently close to open a very interesting field of inquiry, and to show that a sun-spot cycle actually exists in all branches of terrestrial meteorology as well as in the temperatures, the latter question having been definitively established by the researches of Köppen.—12 *A*, 1873, IX., 504.

TIDES IN THE ARCTIC OCEAN.

One of the most interesting results of the *Polaris* arctic exploration has been the deduction based upon the constant and careful tidal observations that were made at Thank-God Harbor. Dr. Bessels says that it was found that, for that place, the co-tidal hour is about 16 hours 20 minutes. Rensselaer Harbor, being the northernmost station, has a co-tidal hour of 18 hours 4 minutes. Consequently the tide comes from the north. The rise and fall at spring tides amount to about 5 feet; at neap tides, 2.3 feet. Most likely the Atlantic and Pacific tidal waves meet somewhere in Smith's Sound, near Cape Frazier.—12 *A*, IX., 404.

THE ACTION OF TIDES ON THE SEA-BOTTOM.

Mr. Reade communicates to the Geological Society of Liverpool the result of a series of novel investigations on the action of tides on the sea-bottom. He shows that, at various points in the St. George's and English channels, and in the Irish sea, tidal currents exist capable of destructive erosive action on the sea-bottom, and that the materials of the Irish sea-bottom are principally composed of rearranged glacial drift, either eroded off the bottom or off the coast by the sea itself, or poured into it by the many rivers. These materials, notwithstanding the oscillatory character of the tidal streams, have in the main a slow progressive motion down the chan-

nel and far out into the Atlantic. It was shown that there are pits or gullies excavated in the bottom in both the English and Irish channels, and that these depressions generally have their major axes conformable in direction with the set of the stream tide. In conclusion, Mr. Reade expresses his conviction that the diurnal and semidiurnal motion of the tides, acting down to the profoundest depths of the ocean, accounts for the preponderance of life in it over that exhibited by the fauna of the Mediterranean.—12 *A*, IX., 316.

PHYSICAL CONDITION OF THE ARCTIC SEAS.

Captain Wells, in a paper presented to the Royal Society upon the physical condition of the arctic seas near Spitzbergen, mentions a very curious fact—namely, that the temperature sometimes increases considerably at great depths. Thus on the 12th of July, when in latitude 80° 17′ north, the vessel being fixed in the ice, the temperature actually increased to +64° at a depth of 600 fathoms, proving, in his opinion, the southward flow of a vast body of warm water. This could not have been derived from the Gulf Stream, because nowhere as high as latitude 50° or 60° does it have so high a temperature at the surface. Even if the whole of the water of the Gulf Stream were spread over the water of the north, its depth would not exceed ten fathoms; whereas warm water of 42° Fahr. occurs to the depth of 400 fathoms, and north of Spitzbergen it is found as high as 64° Fahr. at 600 fathoms.

A northward drift of the Atlantic from warm localities will not explain this fact, since the soundings obtained by Carpenter and others gave temperatures much below 64°. Again, the lower waters flow south, and not north. Volcanic action, or a warm mineral spring, might be given as the cause; but there is no evidence of this, and the true explanation is still a matter of uncertainty.—5 *A*, *July*, 1873, 326.

OCEAN TEMPERATURES IN THE SOUTH ATLANTIC.

Captain Nares, of the *Challenger*, makes an interesting and somewhat unexpected deduction from the observations made by him during the cruise of his vessel—namely, that the cold water at the bottom of the Atlantic, as far north as the Azores and the Bay of Biscay, equally with that at the equator, is derived from an antarctic and not from an arctic source,

since, if at the equator the water supplied from the southward retains its cold temperature to so great an extent, the bottom water of the North Atlantic, if supplied by the nearer arctic, should be at least as cold; but the temperature of the lowest stratum increases decidedly as we pass north, and completely cuts off the arctic water found by the *Porcupine* at the bottom of the Faroe Channel from that discovered at the equator by the *Challenger*, which reached the maximum of 32° 4′.

He also remarks that the bottom water is colder on the western side of the Atlantic, at all the stations south of the Bermuda and Azores lines, than on the east; showing that the antarctic cold current enters the North Atlantic, and runs to the northwestward, through the channels between St. Paul's rocks and the Brazilian coast, and gradually expends itself, as it circles round to the northeastward, in the same manner as the warm equatorial current does on the surface, considering that current as including the Gulf Stream, which Captain Nares thinks it helps to produce. This cold current entering the North Atlantic is found between 1700 fathoms and the bottom, a total thickness of 700 fathoms. Thus the heat-giving properties of the equatorial and northeast trade-current, carrying, as they do, a continuous body of warmed water toward the Caribbean Sea, can be traced by the rise in temperature of the whole body of water at Sombrero, and afterward at all the stations in the North Atlantic, but most readily by the widening of the isotherms about 62°, between America and the Azores, forming an immense reservoir of warmed water 1000 feet thick, and at least two millions of square miles in extent. This change of temperature, or disturbance, is greater and nearer the surface on the western side of the Atlantic, the nearest point to the source of the current, than at the eastern side, where it slowly but gradually expends itself, sinking as it expires.

OCEAN CIRCULATION.

According to Dr. William B. Carpenter, the researches of the *Challenger* completely bear out the views presented by him in regard to the general character and cause of the circulation in the ocean, in the range between 38° N. and 38° S., this conclusion being based upon the facts ascertained in re-

gard to the thermal stratification of an area which may be set down at nearly 15,000,000 square miles, and which has an average depth of at least 15,000 feet. He recapitulates his views in the following propositions:

First. That apart from the horizontal circulation produced by the action of winds upon the surface of the ocean, there is a vertical circulation maintained, in consequence of the difference between the polar and equatorial areas; the whole mass of water contained in any ocean-basin, in free communication with both, being divided into two strata, of which the lower constantly, though slowly, flows over the ocean-bed from the pole toward the equator, while the upper is as constantly flowing from the equator toward either pole.

Second. That the cause of this circulation is the action of surface-cold upon the water of the polar area, which, by reducing its bulk, increases its specific gravity down to its freezing-point at about 27°, so that a column of polar water weighs heavier than a column of equatorial water of the same height. This involves a bottom outflow of cold water from the polar area, producing a general downward movement and a surface indraught. The water thus drawn in will be cooled, and will descend in its turn. On the other hand, in the equatorial area, the drawing off of the warm surface water and the constant arrival of polar bottom water will produce general upward movement, which, by bringing the glacial water under the influence of solar heat, will keep up a difference in weight between the polar and equatorial columns on which the maintenance of this circulation depends.

This general fact has been repeatedly illustrated by Dr. Carpenter by actual experiment, on a small scale.

Third. The amelioration of the climate of Northwestern Europe, proved beyond all doubt to be dependent on a northeast movement of ocean water, does not depend on the extension of the *real* Gulf Stream or Florida current to the North Atlantic, but is the result of the northward movement of the whole upper stratum, in consequence of the surface indraught toward the polar sea. This is shown from the fact of the great depth of its current, which, as far as the Faroe Islands, amounts to 600 or 700 fathoms—a body of water too great to be affected by so small a rivulet, in comparison, as is the Gulf Stream.

From these three theoretical considerations Dr. Carpenter long ago deduced the following generalization: That in all the great ocean-basins the general bottom temperature will approach that of the polar area, in proportion to the freedom of their communication with it. And in this action he anticipates that the bottom temperature of the South Atlantic will be lower than that of the North Atlantic, in consequence of its greater freedom of communication with the polar area; and that while the bottom temperature of the North Atlantic will probably not be as low as 35°, except near the line of the main arctic or antarctic under-flow, that of the South Atlantic will probably be as low as 32°; and, furthermore, that the influence of the stronger antarctic glacial flow will very probably extend to the north of the equator.

Again, he maintained that the depression of the bottom temperature will be found to depend, not upon a mere glacial stream of a few hundred feet in depth, but upon the creeping flow of the whole under-stratum of from 1000 to 2000 fathoms in thickness; and that, as the arctic and antarctic underflows must meet at or near the equator, while the surface stratum is continually drawn toward each pole, there will be a constant ascent of glacial water under the Line, showing itself by the nearer approach of cold water to the surface in the inter-tropical than in the extra-tropical zones.

All these predictions he finds signally verified by the temperature soundings of the *Challenger*, so that he feels that he is justified in maintaining that his original hypothesis in regard to ocean temperatures is established beyond cavil.

The upward movement of the cold water under the equator, according to Dr. Carpenter, is indicated by three distinct facts: first, that the polar water is met with much nearer the surface than in any other part of the area explored by the *Challenger*, the isotherm of 40° there lying within 300 fathoms from the surface, and the whole mass of water thence to the bottom at 2475 fathoms, where it sinks to 34.4°, being unmistakably polar; second, that the surface temperature is thus kept down to a much lower level than it reaches in shallower waters or in inland seas, where there is no cold bottom water to come up and reduce it; third, that the specific gravity of the surface water of the equatorial band has the low standard which the bottom water has brought thither from

the polar areas, while in extra-tropical seas it is considerably higher, having been raised by the prolonged evaporation to which it has been subjected in moving toward them.

THE ANNUAL REPORT OF THE CHIEF SIGNAL OFFICER OF THE ARMY FOR THE YEAR 1873.

The report of the Army Signal-office for the year ending November 1, 1873, has been recently published separately from the report of the Secretary of War (of which it forms a part), and constitutes a volume of about nine hundred pages. According to the report, the service has during the year extended its operations in every direction, including several new and thoroughly novel departments of labor. Passing over the details of the organization of the service, we note that seventy-eight stations are now established in the United States, being an increase of thirteen during the year. In addition to these, five others have been temporarily occupied for special investigations. Reports are also received from eleven stations in the Dominion of Canada. These are received through Professor Kingston, of Toronto, chief of the Meteorological Bureau of the Dominion. Stations are also occupied in the West Indies, at Havana, Kingston, and Santiago. Twenty special stations have been established upon the Mississippi River and its confluents, for the purpose of furnishing in detail the river reports upon which the navigation of those waters so much depends. The publications of the office consist of

1st. Tri-daily bulletins of synchronous observations.

2d. Tri-daily weather maps, with the accompanying synopses and probabilities.

3d. The daily Post-office bulletin.

4th. The cautionary storm-signals.

5th. The cautionary river flood dispatches.

6th. The regular daily river reports.

7th. The weekly chronicle, published each day of the week for the preceding seven days.

8th. The monthly weather review, with its accompanying charts of storm-tracks, isobars, isotherms, winds, rain-fall, etc.

9th. The monthly book of synopses, probabilities, verifications, and facts.

10th. The annual report, embracing meteorological results

for the year, and special memoirs relating to important meteorological phenomena.

The Post-office bulletins are published daily at 4500 different post-offices, through the co-operation of the War and Post-office Departments. At the request of Professor Baird, United States Commissioner of Fish and Fisheries, observers favorably located are required to take daily observations of the temperature of the water in the respective rivers and harbors. In obedience to the Act of Congress of March, 1873, a telegraph line has been completed along the coast of New Jersey for a distance of fifty miles, and will rapidly be extended from Cape Hatteras to Cape Cod, Signal Service observers being stationed every ten or fifteen miles along the coast. At the request of the Hon. Francis A. Walker, Superintendent of the United States Census, meteorological charts, showing the average storm-frequency, the velocity of the wind, and other interesting details, have been prepared to form part of the statistical atlas of the United States. A large number of logs of vessels have been collected by the office, in pursuance of the study of the phenomena of the storms experienced at sea. One hundred and twenty-five extensive storms have been experienced in the United States during the year, of which 88 have been sufficiently severe to demand the display of cautionary signals. The winds considered as dangerous by the Signal-office, and justifying the display of the cautionary signal, are those that reach a velocity of twenty-five miles per hour, as registered by the anemometer on the land. The direction of the wind is not taken into consideration. If within eight hours the danger appears not to be imminent, the signal is at once ordered down. It is not displayed for an indefinitely long time, as is the custom in Europe. Cautionary dispatches are sent to Canada when storms apparently threaten Canadian ports. The percentage of verifications of the predictions contained in the so-called probabilities varies from 82 in New England to 74 in the Northwest. These percentages have been obtained by a careful analysis of the predictions, and a comparison of them with the facts subsequently obtained from the weather reports. The percentage of verifications exhibits a proportion to the number of stations from which reports have been received, and thus, to a limited extent, demonstrates that the rules employed in the deductions

of the forecast are practically correct. The presence of the Chief Signal Officer at the Meteorological Congress held in Vienna, in September last, secured the co-operation of a large number of the individual countries of Europe in the system of synchronous observations established in the United States. Among the appendices to the report of the Chief Signal Officer, we notice the following as of special scientific interest:

Tables are given of monthly, annual, and mean pressures and temperatures; daily maximum and minimum temperatures; monthly and annual rain-fall; and the frequency of winds for all the Signal Service stations. The observations made at St. Paul's Island, Aleutian Archipelago, are given in detail, as also are those made on the sides of Mount Washington and Mount Mitchell. The altitudes of all the stations, above sea-level, have been very carefully deduced by Professor Abbe, from the vast mass of railroad levelings accumulated by the office, and are given in detail. The report of Sergeant Myer, of the *Polaris* expedition, and the report of Professor Abbe on the great Nova Scotia cyclone, are also introduced in full. A very complete table is given, by Professor Lapham, of the disasters occurring to American shipping on the lakes. Sergeant-observer McIntosh contributes the details of a tornado in Iowa. This paper is probably the fullest and most valuable monograph on this subject to be found in meteorological literature. The report concludes with a chronological list of all the auroras recorded by the Signal Service observers from 1870 to 1873, inclusive, compiled by Professor Abbe.

TEMPERATURE OF ATLANTIC SURFACE WATER.

For many years the Royal Meteorological Institute of the Netherlands has systematically labored in the arrangement and study of an immense mass of observations on the temperature of the wind and the currents of the ocean. The Institute has recently elucidated the subject of the physics of the ocean by the publication of a series of charts, detailing the temperature of its surface water for each month and year over that portion of the North Atlantic included between thirty and fifty-two degrees north latitude, and zero and fifty degrees west longitude, the region, therefore, most frequently traversed by the vessels of Europe and America. Over 51,000 observations made by the navy of Holland, and

with instruments that had been compared with a standard, are presented synoptically. The author (Cornelissen) takes occasion to call attention to the notably higher temperature which prevails westward of a line drawn from the southern point of Ireland southward. A decided difference is shown between the cool waters washing the Spanish and African coasts and the Azores, and the warmer waters lying to the westward.—*Zeitschrift für Meteorologie, November*, 1873, 239.

CLIMATE OF TIFLIS.

Dr. Moritz, director of the Meteorological Observatory at Tiflis, in the Caucasus, gives a short sketch of the extremes of the most important meteorological elements for that city, which afford an interesting basis for comparison with similar regions in the United States. It appears from Moritz's table that the highest barometric pressure during the past ten years occurs, on the average, in November and January, and the lowest in July. The highest temperature recorded is 101.8 degrees, which extreme temperature has been reached on three occasions, respectively in the months of June, July, and August. The relative humidity of the air is recorded on two occasions as low as twelve per cent., on twelve or more occasions lower than twenty per cent. In reference to this important element, Moritz remarks that the Tiflis observations completely demonstrate the error of those who have long maintained that regions in which the moisture of the air is lower than seventeen per cent. are uninhabitable for mankind, inasmuch as in Tiflis, on the average, five times in each year, the relative humidity is less than that mentioned. —*Zeitschrift für Meteorologie, November*, 1873, 239.

THE USE OF HIGH STATIONS IN WEATHER PREDICTIONS.

Jelinek states that the decision as to the method according to which barometric observations made at stations at various altitudes shall be treated in order to make them comparable among themselves and useful for the publications of weather telegraphy, offers a theoretical and practical interest, and he therefore states with fairness some, if not all, of the arguments that have been urged, pro and con, in reference to both the method of the abnormal deviations and that of reduction to sea-level. Theoretically, it certainly is true, as ac-

knowledged by him, that we have no assurance of the correctness of any of the reasons that have been urged in favor of the latter method, and these same objections hold good, though to a less extent, in reference to the method of deviations. On the other hand, it would seem that, in Jelinek's opinion, the strongest argument in favor of the introduction of the method of reduction to sea-level consists in securing thereby a uniform method in meteorology—a uniformity that seems to him so extremely valuable that other considerations must sometimes be made to stand aside. As to the details of the application of this method, he agrees with Wild in perhaps every thing except that he would prefer the Laplace tables to those of Ruhlmann, although the latter attempts to secure a higher degree of theoretical accuracy. He therefore urges its exclusive application in all telegraphic weather reports.

From Jelinek's communication, as well as that of Wild, it is evident, however, that the needs of European stations are far different from those on this side of the Atlantic. He states, in fact, that elevated stations will never furnish data that can be comparable with that given by the stations near the level of the sea. They must, therefore, not be applied in making use of telegraphic weather reports, as is also the case with those stations that are situated in localities subject to peculiar anomalies of temperature. When, however, it is necessary to use these observations because there are none at hand from stations situated at a lower altitude, then the data in question must be made use of in a method quite different from that employed for the coast stations; namely, only as indicating the changes going on in the middle layers of the atmosphere.

THE INFLUENCE OF THE CONDITION OF THE EARTH'S SURFACE ON THE PRECIPITATION OF RAIN, HAIL, ETC.

The unusual character of the climate of the Russian dominions, in the province of Caucasus, in the year 1869, has incited Abich to a very thorough study of the formation of hail, and the general interdependence between the aqueous precipitation and the condition of the earth's surface. His memoir is published in the first volume of the "Materials for the Meteorology of the Caucasus," edited by Moritz, director of the ob-

servatory in Tiflis. Abich considers, especially, the meteorological influences of forest growth, and of altitude above the sea-level, and states very strongly his opinion that only a complete misunderstanding of the facts related by him, and of the general conclusions of other students, especially those of Mühry, could lead one to believe that the influence of the forests can be insignificant upon climatology, and especially upon the cultivation of the soil; the preservation of forests must therefore be considered as an object worthy of most serious consideration and earnest national enterprise. Within the foliage the moisture of the atmosphere is condensed; and in consequence of a complicated process, it results that, from the upper surface of the foliage of a forest, cold air flows down. This air slightly raises its temperature, and preserves the earth, in the interior of the forest, at a temperature several degrees higher on the average than that which is not protected. The forest, in fact, operates in a manner very similar to the ocean or a large lake. As the sea wind blows upon land during the daytime, so during the daytime the cold air of the forest blows out toward the open fields. As the land wind at night flows toward the ocean, so in the evening the cold air in the forest, receiving the warmth of the warm earth, rises up, while the cool air from the exterior region flows in to take its place. This daily vertical compensating circulation has an intensity proportional to the extent of the forest and the barrenness of the soil that is not protected. In regard to the formation of hail, he concludes that it is determined by the conditions existing in the upper regions of the air; but the direction of the movement of the hail-storm, and its variable intensity, from point to point, are principally determined by local influences, and especially the vertical currents of the atmosphere that depend for their existence upon the presence of forests, heated plains, rivers, etc. —*Moritz, Materials for the Climatology of the Caucasus*, vol. i.

ON THE PERIODICITY OF CLIMATES ON THE EARTH.

The question whether there are any other regular periods in meteorology than the daily and annual has, as is well known, attracted great attention of late years in connection with the supposed discovery of an eleven-year period coinciding with the increase and diminution of the solar spots.

Such a period has been argued from observations of temperature, terrestrial magnetism, auroras, atmospheric electricity, and, finally, the recurrence of cyclones in the Indian Ocean. The most extended labor on this subject is, however, that of Dr. Köppen, of the Physical Observatory of St. Petersburg, who has, with great labor, brought together an immense mass of observations of the temperature in order to establish his conclusions upon irrefragable bases. In his opinion, in which doubtless all coincide, it is absolutely necessary that observations should be gathered together from all regions of the world, and that our conclusions be not based upon a single series made at any station, or over any country. There seems to have been no observations of temperature made in any portion of the world that have not been used by him, so that his conclusion may be said to embody all that can be deduced from the present state of observational meteorology. Arranging the stations according to meteorological zones—the tropics and subtropics, the warmer temperate zone, the colder temperate zone, and the cold zone—he throws the mean temperature for each year and each zone into the graphic form of a curve, which can then be directly compared at a glance with the curve of sun-spots as deduced by Wolf from all known observations of the sun. At the very first one is struck with the great agreement of these curves. In the torrid zone the maximum of heat occurs from six to eighteen months before the spot maximum. To the north of the tropics the maximum of temperature occurs still later than the minimum of spots, being retarded even as much as three years. The regularity and magnitude of the variations of temperature are most beautifully displayed within the tropics, and diminish as we proceed thence toward the poles. The length of the period between the maximum temperature varies, as also does that of the sun's spots, thus, as the interval between the minimum and maximum of spots is almost always shorter than the interval between the maximum and minimum, so does the temperature follow a precisely corresponding change. The parallelism in the series of numbers is so great that there no longer remains the slightest chance of a mere accidental coincidence between these apparently independent variations. The two phenomena evidently are connected, but in what manner can

not at present be determined. Only this is clear, that the sun's spots do not directly, through the darkened portion of the sun's disk, act like an eclipse, leaving the remaining portion of the sun's disk to shine upon the earth with undiminished intensity; for were this the case, since the temperature on the earth's surface is a summation of the total radiation from the sun, it would follow that the variation in the temperature would necessarily follow later than its cause—that is to say, the minimum temperature on the earth should, to a certain extent, follow the maximum number of sun-spots. The contrary, however, is the case, the number of sun-spots attaining its maximum after the corresponding maximum of temperature in the tropics; and it appears to the author most likely that the temperature of the sun's surface, from some unknown cause, is highest one or two years before the minimum of the solar spots. Regarding these spots as comparatively cold matter slowly melting away on the glowing surface of the sun, he remarks that it can not be surprising that the spots should occupy so great a time to completely melt when we consider their immense dimensions. He, however, finds no explanation of the remarkable fact that the retardation of the temperature on the earth's surface, with respect to the sun's spots, is greater near the poles than at the tropics, unless it have to do with the phenomena of the moisture in our atmosphere. To this subject, therefore, he proposes to direct attention. In conclusion, as the result of his studies into the appearance of extremely hot and cold years, he states that, according to the data now before him, there is reason to expect a very cold year, in 1875, in Europe.—*Zeitschrift für Meteorologie*, *November*, 1873, 241–265.

DIURNAL VARIATIONS OF THE WIND AND BAROMETER AT BOMBAY.

C. Chambers, director of the Colaba Observatory at Bombay, brings to notice a remarkable relation that has been found to exist between the diurnal variations of the wind and barometer at Bombay. Besides the well-known diurnal variations of the wind, known as the land and sea breezes, the author shows that certain peculiarities of the wind-curve are due to the superposition of a distinct variation, having two maxima and two minima, like the barometer variation;

and he supports his views by a reference to the months of July and August, at which time the land and sea breezes almost disappear, and there is found a decided double period. These variations are regarded as indicative of the existence of a double diurnal variation in the general movements of the atmosphere. The wind records at St. Helena, Toronto, and Falmouth are also shown to exhibit a greater or less agreement with those of Bombay, and the author points out their applicability in deducing probabilities and discussing storms.—*Pr. Roy. Soc.*, 1873, 384.

SUNSET TINTS AND ARCS.

Mr. Winstanley communicates to the Literary and Philosophical Society of Manchester the result of numerous observations made by him on the color of the last glimpse of the sun at sunset. Mr. Baxendell and Dr. Joule had previously observed that the last visible portion of the sun became clear blue or bluish green just as it vanished. Mr. Winstanley, after more than fifty observations, states that the color is by no means constant, being as often blue as it is bluish green. Its duration is likewise variable, being from half a second to two seconds and a half. When examined with the assistance of a telescope, it becomes evident that the green ray begins at an early stage of the solar obscuration at the points or cusps on the visible segment of the sun; and, when the setting is nearly completed, it extends from both cusps to the central space between. The color, as seen in the telescope, is more varied than when the observation is made with the naked eye. The different colors, together with the order of their appearance, show that the cause of their production lies in the prismatic action of the atmosphere. By projecting a large image of the sun in a darkened room, Mr. Winstanley was able to get the whole of the spectrum produced by the prismatic action of the atmosphere in a very satisfactory manner.—12 *A*, IX., 20.

METEOROLOGY IN THE ARGENTINE CONFEDERACY.

The first annual report of the Meteorological Office of the Argentine Confederacy, as recently delivered, has just been received, and from it we perceive that the director, Dr. B. A. Gould, who is also astronomer of the Confederacy, has en-

deavored to combine both scientific and utilitarian objects in this new enterprise. His first aim, he states, has been to enlist the physician, the agriculturist, the landed proprietor, and the navigator in the acquisition of thoroughly trustworthy and complete observations, and in those special inquiries which appear most essentially to pertain to each class of observers. The acquisition of new standard instruments has been attended with great and unexpected delays, but considerable success has been achieved in the collection of old meteorological records extending over very considerable periods of time. The larger part of the outfit of the observing stations has been ordered from Negretti & Zambra, of London, while aneroid barometers are expected from Goldschmidt, of Zurich. The tables printed by the Smithsonian Institution have been adopted in the reduction of the observations. Among the special results we may mention the mean temperature at Cordova for the year, which has been 61.7° Fahr.; the mean barometric pressure, 28.465 inches. The entire range in barometric pressure has been only 1.1 inches. The driest month has been that of October, 1873, while the greatest average relative humidity occurred in February. The total rain-fall at the observatory is 32.4 inches, being apparently very slightly less than fell in the adjacent city. Similar means are also given for Bahia Blanca and for Buenos Ayres. Frequent reference is made in Dr. Gould's report to the character of the work of the United States Army Signal Corps, with which body his meteorological office is in frequent correspondence.—*Buenos Ayres Weekly Standard, March* 18, 1874.

INFLUENCE OF THE MOON ON THE WEATHER.

Wierzbicki, assistant at the observatory at Cracow, has made use of forty-five years of continuous observations on the climate of that station to investigate the influence of the moon. The first person who made any practical investigation of this subject appears to have been Laplace, who studied the influence of the moon upon the height of the barometer. In the same direction also Bouvard labored, basing his investigation on twelve years of observations at Paris, and he proved that the influence of the moon upon atmospheric pressure was so inconsiderable, at least for the latitude

of Paris, that it might be considered as not existing at all. Wierzbicki divides his investigation into two sections; studying first the influence of the synodic revolution of the moon, or the time that the moon occupies in passing through all its phases, and further subdividing the period of forty-five years into two periods of nineteen years each, and showing that for both of these periods, as well as for the entire period of forty-five years, the clear weather (*i. e.*, the number of clear days) shows scarcely any trace of a connection with the phase of the moon. During the lunar month, in fact, the number of clear days increases and diminishes five times, and without any apparent regularity.

With regard to the rain-fall, it appears that in the first period of nineteen years the maximum rain-fall occurs between the first quarter and the full moon, and the least rain-fall between the full moon and the last quarter. On the other hand, the last period of nineteen years leads to a different result; so that, from the whole series of observations, there results only a very slight indication of a connection with the moon—which connection, if it actually exist, would require for its demonstration a series of measurements of the rain-fall extending through a much longer period of years. The result attained by the study of the number of days on which rain fell substantially agrees with that from the study of the quantity of rain fallen, in showing that the moon has very little, if any, influence upon processes in our atmosphere. The same author, in studying the anomalistic revolution of the moon, gives, by a very careful process of reasoning, two conclusions different from those advocated by Schiaparelli, in finding no trace of the influence of the distance of the moon from the earth upon meteorological phenomena.—*Jahrbuch K. K. Centr. Anstalt Meteor.*, 1873.

MARITIME METEOROLOGY.

The interest which has increased so rapidly during the past few years in reference to maritime meteorology gives additional value to the sixth annual report of the North German Nautical Institute, the well-known Seewarte at Hamburg. The steady development which this institution has experienced, under the energetic directorship of Von Freeden, is manifested in the engagement of almost twice the former

number of persons upon the works that it has undertaken, and the director states that the publication of the weather charts of the North Atlantic will be possibly achieved within two years; that, in fact, the small means at his disposal has required that too large a proportional amount of labor should be given to the current work of the office, and that the mass of material now on hand already surpasses his ability to reduce to a form proper for publication. He anticipates that when all the observations have been entered upon the charts, he will be able to designate the details of the weather, for each square of one degree in latitude and longitude, with a minuteness that has not as yet been attempted by the charts in current use. Full attention will be given to the winds, the temperatures, and the currents, the tracks of vessels, and sailing directions for the various routes of the North Atlantic Ocean. Of the forty-eight sheets that will comprise the entire chart, four sets of charts have already been sent to press, and the whole will cover the belt of the Atlantic Ocean between the longitnde of Greenwich and 100° west, and from the equator to 60° north. The winds and currents, as published by him, are taken only from the records of sailing-vessels; the temperature of the water from the records of all classes of vessels. He cites it, as a satisfactory demonstration that the German navigators employ the most rational methods in the conduct of their vessels, that, on all the seas and in all the voyages, the German ships have, on the average, excelled their companions in rapidity. The Hamburg Institute receives storm-warning dispatches from the Meteorological Office in London, and displays storm-signals similar to those in use throughout Great Britain.—*Sixth Annual Report N. Ger. Naut. Inst.*, 1873.

SIGNALS OF THE LONDON BOARD OF TRADE.

The London Board of Trade announce, in behalf of the Meteorological Committee, that on and after March 15, 1874, they propose to reintroduce the use of Admiral Fitzroy's signals of cones and drums. A cone exhibited with the point downward indicates the approach of a southerly gale, southeast round by south to northwest; a cone pointing upward indicates a northerly gale, northwest round by north to southeast; a drum *with cone* indicates the probable approach of a

very heavy gale from the direction indicated by the cone. These signals will be hoisted, during daylight only, until forty-eight hours have elapsed from the time the telegram was dispatched. At night, lanterns may be used wherever the local authorities deem it advisable.—12 *A*, *March* 19, 1874, 390.

CHINESE METEOROLOGICAL SYSTEM.

At the recent meeting at Vienna of the International Meteorological Congress there was present Mr. Campbell, representing Mr. Hart, General Inspector of Marine Revenue for China. Mr. Hart presented documents showing that the Chinese government had determined to establish a system of meteorological stations, and to institute the telegraphic method of storm warnings, placing the whole in charge of Mr. Campbell himself. Mr. Campbell solicited the suggestions of the members present at the Congress as to the points to be kept in view in establishing the Chinese meteorological stations; and among these suggestions, besides urging the importance of uniformity in comparison with other national systems, the Congress expressed its opinion that the execution of all the duties resting upon such a system could only be secured by the employment of special officers as contrasted with the voluntary system in use in Europe. The Chinese meteorological system will be entirely separate from the Professorship of Astronomy at the College of Pekin. Four stations of the first order are suggested—namely, Shanghai, Pekin, Hankow, and Amoy.—*Bericht Meteor. Congr., Wien*, 28, 64.

CONNECTION BETWEEN COLLIERY EXPLOSIONS AND THE WEATHER.

Messrs. Scott and Galloway have made a careful comparison of the weather records, for the year 1871, with the records of fire-damp in the coal-mines of Great Britain. From nearly 300 such explosions during that year they have derived the following general conclusions:

They find that out of 207 explosions, 113 were due to the state of the barometer, 39 to the temperature, and 55 not accounted for by either of these agencies. If the barometric pressure, after having remained about the same height for sev-

eral days, descend half an inch or an inch during the next two or three days, fire-damp may be expected in greater quantity than usual. As the curve of temperature rises to fifty-five degrees and upward, the ventilating power should be increased at the same time, and the higher the temperature the greater is the necessity for such increase, in order to prevent, if possible, stagnation of the ventilating current. If a sudden great fall of the barometer take place—say, an inch in twenty-four hours—or a further fall after it has been unusually low for a day or two, the utmost care will be necessary to guard against explosions, more especially if a rise of temperature accompany the fall of the barometer.

In conclusion, the opinion is expressed that the majority of the explosions can be prevented by good ventilation. Fire-damp would be almost unknown in many mines with a plentiful unvarying supply of air introduced and properly distributed. The observations indicate that, in order to confine the chances of explosions within the narrowest limits, it will be necessary to introduce an instrument that shall keep a constant record of the whole ventilating power employed, natural and artificial.—*Quar. Jour. Meteor. Soc.*, 1873, 246.

THE WEATHER OF DECEMBER, 1873.

The monthly weather review of the Army Signal-office for December gives the details of twelve storms, of greater or less severity, that have prevailed within the limits of the net-work of stations maintained by the United States and Canadian governments. Two of these storms started from the northwestern portion of the Gulf of Mexico, and passed along the Atlantic coast to the eastward of Nova Scotia. Four started from Western Texas, and passed northeastward over New England and Canada. Six came from the extreme Northwest, and passed nearly eastward over the Lake region. Of all these storms, that which passed over Kansas on the 2d of December, and moved thence over Lakes Michigan and Huron, was by far the most severe. It was accompanied with snow from the Lake region westward to California, with unusual cold. On the 1st of December, probably in connection with the storm, a heavy sand-storm was reported at Yuma, New Mexico. There were hoisted at American ports sixty-three cautionary signals, and for Cana-

dian ports thirty-four storm warnings were telegraphed. Of these signals, seventy-three per cent. are known to have been justified. From the newly established life-saving stations on the Middle Atlantic coast have been received such news of the saving of life and property as to fully justify the belief entertained concerning the usefulness of this branch of the service. As a general rule, the thermometer has every where ranged decidedly above its average value for December. The greatest excess of warmth has been in the Lake region. A slight deficiency in rain-fall in the Southwest appears from the reports; but it is stated it will probably not be felt seriously in the agricultural regions, inasmuch as there was an excess of rain-fall in November. The highest stages of the Mississippi are reported from Cairo, Memphis, and Vicksburg, on the 18th, 23d, and 30th of the month respectively. We miss the statement of the temperatures of the water at the river and ocean stations, a feature of much interest to the fisheries of the country, and, indeed, to many other industries besides. Auroral displays have been rare and very faint. The amount of fog which prevailed in December was very great. In the latter part of November vast prairie fires occurred in the far West, and several dust-storms, followed by a *dry, black rain*, are reported. From the recently established station on the summit of Pike's Peak, Colorado, among other interesting observations, it is reported that at the time of sunset there appeared to the northeast a heavy mist overhanging the plains, and on this mist was depicted, by means of the setting sun, a perfect shadow and profile of the mountain. This continued for the space of fifteen minutes.

METEOROLOGY IN BENGAL.

The report for the year 1872 of the meteorological reporter to the government of Bengal, H. F. Blanford, has recently come to hand, filled with its usual valuable tables of monthly means for numerous stations from observations taken four times a day, and affording a complete view of the climate of Southern India. In the latter portion of the book very valuable information is given in reference to several storms. It is stated that the most striking characteristic of the meteorology of 1872 was the greater frequency of storms in the Bay

of Bengal, both at the beginning and end of the monsoon; and that the atmospheric pressure over the northern portion of the bay was low during the greater part of the year. The most memorable of these cyclones was that of the 28th of June and the 1st of July. This is the only storm on record that has been generated so close to land in the northwest corner of the Bay of Bengal. To this and to the high resistance offered by the land to the motion of the wind is attributed the fact that the storm was so long in process of formation and so speedily broken up. The state of winds and weather on the 25th of June is specially commented upon as being very instructive in regard to the genesis of the cyclone. There had been an area of relative low pressure for three days in the north of the bay, and a strong gale blowing from west-southwest in the middle of the bay to the southward; but to the north of the low pressure, and over Bengal, the wind was still light from southeast, and yet no cyclone was formed. Over the depression, as well as to the south, the rain was exceedingly heavy, but the winds were light from the southwest, consequently there must have been an ascending current over the area of low barometer, which the heavy rain-fall must have helped to increase. That no cyclone was formed must be attributed to the proximity of the land to the northward of the barometric depression. The case seems to Mr. Blanford strongly confirmatory of views long held by him on the formation of cyclones in the Bay of Bengal.

From the report of the same gentleman, for part of 1873, we learn that at six stations in Bengal the observers are also in charge of local telegraph offices. They are provided with full sets of instruments, and observe daily at four and ten o'clock A.M. and P.M. At ten other stations native observers are appointed under the direction of the civil surgeons. A third class of stations report rain-fall only, and the total number of these at present is 139. The published daily weather reports consist of a weather telegram from the first-class stations at ten A.M. and four P.M. Storm-warning signals were exhibited on the 29th of June and 1st of July, during the existence of the severe cyclone. Since this storm occurred a bad-weather signal has been added to the warning and storm signals. It is to be exhibited whenever there appears to be bad weather in the bay, whether there is reason to believe

that a cyclone is formed or not. These signals are displayed at four stations on the coast.—*Report Meteor. Reporter for Bengal for* 1872; and *Report Meteor. Reporter for Bombay for* 1873.

MOVEMENT OF STORM-CENTRES.

The laws of the movement of storms are now being diligently studied at all the national meteorological institutions of the world, and at none are there better means of pursuing such studies than at St. Petersburg and Washington. The rules adopted by Professor Abbe were indicated in a popular pamphlet published in the spring of 1871, soon after the Army Signal-office began to issue the tri-daily weather probabilities as compiled by him. In this pamphlet the connection between an abnormal rise of temperature and the probable future course of a storm-centre is dwelt upon; and we have now to record a valuable investigation into the details of this connection by Lieutenant Baron Maydell, assistant at the Central Physical Observatory at St. Petersburg, who states that his attention was specially called to this by the study of the storm of February, 1873. From the consideration of all the storms of Northern Europe during 1872 and 1873, Maydell deduces the following generalizations.

In advance of such barometric minima as make themselves felt on the west coast of Norway, the tension of the aqueous vapor and the temperature, to a certain distance south of this place, rises. In the progress of the storm-centre both these elements, temperature and tension, retain, for any given day, to a greater or less extent, the same position in reference to the barometric minimum, and therefore must advance in the same direction with it. The variations of absolute humidity correspond closely to those of the temperature.

In attempting to make use of the temperature changes in his predictions of storms, Maydell concludes as follows: The storm-path for the next twenty-four hours forms a determinate angle with the line connecting the present place of the barometric minimum with that of greatest rise of temperature. This angle is always formed on the left hand of that connecting line, supposing the face to be turned toward the point of rising temperature, and the back toward the point of minimum barometer. This angle he finds to vary between

zero and ninety degrees as the extreme cases, while it is on the average in winter about sixty degrees, and in summer either forty or seventy degrees. The angle depends, to a certain extent, upon the position of the centre of highest temperature, being smaller according as this point lies more to the east of the barometric minimum. While these rules hold especially for the coast of Scandinavia, similar rules have been determined for Finland; and it is evident from the experience of other meteorologists that Baron Maydell has but given definite expression to a law that applies very generally throughout the terrestrial sphere, changing only the notation when we pass from the northern to the southern hemisphere, and also as we pass from the equatorial to the temperate regions of the earth. The angles determined by him are evidently affected by the configuration of the coasts of Northern Europe, and quite different values must obtain in our own country.—*Bull. Centr. Phys. Observatory, St. Petersburg, December*, 1873.

EBERMAYER ON A NEW TEXT-BOOK ON CLIMATOLOGY.

The new work of Lorenz and Rothe on climatology has an important bearing upon all questions of the cultivation of land, whether pertaining to forestry, or to agriculture as ordinarily understood. This work teaches us how the study of climatology must be followed in order to deduce valuable practical consequences therefrom. Thus far, we believe, the study of meteorology and climatology in its relations to agriculture has been shamefully neglected, even in the so-called agricultural colleges, and the volume in question will we hope soon be translated from its original German, and adopted as a text-book in our own country. The special value of this work, according to Ebermayer, lies in the fact that it gives no simple dogmatic climatological recipes, but rather leads the reader systematically from the simple phenomena to the more complicated ones, and makes him acquainted with the causes of the manifold climatic differences that are found upon our earth, enabling him finally to attain a complete understanding of the climatic peculiarities of any given place from the ordinary instrumental meteorological records. The book, which comprises nearly 500 pages, treats of the following climatic elements: namely, light, warmth—both of

the earth, water, and the air; then the circulation of water—evaporation, moisture, and precipitation; then the statics and dynamics of air, as pressure and its currents; and in all these points presents views adapted to the present condition of the science of meteorology. We miss a chapter upon the actinic power of the solar rays, or the wonderful and complex constitution and influence of the molecular vibrations that radiate from the sun, and which are the active cause of all life on the earth. A second portion of the book handles the questions of climate and climatography in such a manner that one follows with great interest the exact presentation and analysis that is offered. The introduction, which is written by Dove, calls attention to the originality and lucidity which distinguish the climatological portion of the book: "The fundamental idea seems to be that meteoric phenomena as well as the climatic relations are referred back to the currents of the atmosphere, and that, not only does the wind make the weather, but that it is itself the weather"—a principle that was, we may state, early adopted in the predictions of "Old Probabilities," as was stated in one of the first publications of the Weather Bureau.* The relation of forests to the climate are treated with great thoroughness, as might be expected from the accessibility of the well-known and important work of Ebermayer in this field of investigation. Although the work of Lorenz and Rothe is specially adapted to Europe, it gives a short review of the climatic characteristics of America, Asia, Australia, and Africa, and is at present by far the best work available even for the American student; and it is to be hoped that very soon it may find its way into the hands of every one who in the least degree devotes himself to these studies.—*Jelinek*, *Zeitschrift Met.*, IX., 106–126.

THE ACOUSTIC TRANSPARENCY OF THE AIR.

The important experiments made by Professor Tyndall relative to the intensity of sound under various conditions of the atmosphere have called forth from Professor Challis a theory of the effects produced by fog and vapor, which is of as great importance as the memoir presented to the Royal

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* "Suggestions as to the Practical Use of the Weather Maps."

Society by Professor Osborne Reynolds on the phenomena of the refraction of sound by the atmosphere. Professor Challis distinguishes the phenomena as those resulting from fog, and those due to the admixture of air and invisible vapor. Assuming that fog, or haze, is due to the suspension in the air of extremely minute globules of water, Professor Challis determines the velocity and condensation of the air due to the reaction of a single small sphere on which acoustic vibrations are incident. He shows that, on account of the small size of the globules, the reflection from a single globule may be so extremely minute that the sum of the reflections from a large number of globules may only generate reflected waves of moderate magnitude, and apparently coming from a great depth. Challis's theory points to no change in the rate of propagation of sounds, but only to an alteration of their intensity. But, passing to the effect of vapor in an invisible state mixed with the air, he shows that, whether this vapor is connected with the air only by a kind of mechanical suspension, or whether the mixture is so regular that there are found changes of density more or less rapid as we pass from point to point, without change of elasticity, it will still happen that the air will be, in various degrees, impervious to sound —7 *A*, 1874, XLVII., 276.

SUN-SPOTS AND TERRESTRIAL METEOROLOGY.

Wolf, as the result of recent study on the influence of sun-spots on temperature and rain-fall, states that he is brought to the conclusion that, in the regular course of the sun-spot phenomena, great frequency of sun-spots corresponds to lower temperature and greater quantity of rain; that, on the other hand, at a time when the sun-spots and their variations enter upon anomalous changes, these relations no longer hold, but have almost the opposite character.—*Astron. Nach.*, LXXXIII., 158.

RAIN-FALL AND SUN-SPOTS.

Wolf, of Zurich, has just published the results of a study into the connection between sun-spots and rain-fall, on which subject, indeed, he has already published several valuable articles. As his latest results, he states that he has investigated the observations of rain-fall for Paris, Upminster, Bordeaux,

and Zwanenburg, for the years 1690 to 1784, and finds that, from 1723 to 1766, each minimum of sun-spots corresponds to a less rain-fall than the preceding, and following sun-spots maxima; but that, on the other hand, before 1723 and after 1766, the reverse takes place.—*Astron. Nach.*, LXXXIII., 286.

SOLAR SPOTS AND TERRESTRIAL PHENOMENA.

The last number of the Astronomical Notices of Dr. Wolf contains a valuable contribution by him to the literature of the solar spots and their relation to terrestrial phenomena. As is well known, Wolf's previous studies on this subject have been the starting-point of nearly all the most recent investigations that have been made; and, indeed, his series of numbers representing the relative spot area of the sun's surface during the past 200 years is the standard authority relating to that subject. The present communication begins with the consideration of the subject of the relation between magnetic variation and the frequency of sun-spots; and the author first of all prepares a table showing the magnetic variation, in Europe, for over 100 years, founding his studies upon long series of observations made at eight stations. The magnetic variation at each station is represented by a formula so satisfactory that Wolf concludes that the simultaneous variations at different places vary among themselves, principally, by a constant quantity, and the influence of the sun-spots is nearly the same for each series. Hence he is justified in considering all these eight stations as representing, in general, the magnetic condition over Europe. The mean of the separate results belongs, therefore, to a station in the midst of the eight stations. As a central normal station, Wolf chooses the city of Prague, for which the longest series of observations is at hand. He is then able to find a normal variation, which may be considered to be, to a great extent, freed from the influence of local peculiarities. When the spot phenomena are irregular, so also are the variations; when they increase or diminish, the magnetic variations do so likewise. In his last communication on the solar spots, Wolf states that in 1852 he showed, from a review of eight centuries of weather notes in the older chronicles of Switzerland, that the years rich in sun-spots are, in general, drier and more fruitful than those that are poor in sun-spots, the

latter being wet and stormy. But in 1859, when he had accumulated far more accurate materials with reference to the solar phenomena, he arrived at a result which he considered more accurate than that deduced by him seven years earlier: namely, that, in general, the years poor in sun-spots were accompanied by only a very slight excess of temperature; and, in view of all the circumstances, he decided that between the earth's temperature and the solar spots there existed either no connection at all, or one so slight that it could not show itself in the mean yearly temperatures. During the past two years, however, the important works of Meldrum, Köppen, and Celloria have appeared, and have seemed to him to show that the subject is still worthy of attention. Wolf finds that the remarks of Köppen, to the effect that there is a perfect parallelism between the changes in solar spots and the changes in terrestrial temperature, may be true at certain epochs, but at other times they present us with most remarkable riddles; and he would incline to adhere to his former conclusion that there is really no close connection between temperature and sun-spots, did it not happen that precisely in those years where the temperature ceases to follow the solar spots, there also the curve of magnetic variations exhibits a remarkable discordance; and that in respect to the behavior of these three phenomena, in the years 1778 and 1789, we at present stand, as it were, before one of the most remarkable enigmas in terrestrial physics, whose solution can but throw light upon this subject in all directions. Passing to the consideration of the rain-fall, Wolf finds a slight probability in favor of the law, announced by Meldrum, that a periodicity actually exists in the rain-fall in tropical regions similar to the solar-spot period.—*Wolf's Astron. Mitt.*, No. 34, 134.

METEOROLOGY OF THE UNITED STATES.

The annual report of the secretary of the Smithsonian Institution for 1872 reviews its general progress during the twenty-five years that have elapsed since he was called to its superintendence. In speaking of the meteorological work that has been carried out under him, after explaining the circumstances under which the Smithsonian has relinquished the field of meteorology to the Army Signal-office, he explains

the present condition of the labors that are in progress, looking to the publication of works on the climatology of North America, based on the data that have been accumulated by him. With reference to temperature observations, it is stated that they have been in charge of Mr. Schott, of the Coast Survey, and the first division of the work has been already sent to press. This section consists of tables and discussions necessary to reduce observations taken at different times of the day to the true mean of the day. It includes general remarks on the explanation of the daily fluctuations of the temperature, tables of sunrise and sunset, Bessel's formulæ for representing the daily fluctuation, the variability of the temperature at any hour as compared with the normal value for that hour, and tables of the daily fluctuations of temperature, showing for each hour, month, and year the difference between the observed and the mean temperature. Attention is also called to the importance of obtaining observations on the rate of increase of temperature as we descend into the earth, a matter to which the British Association for the Advancement of Science has lately paid some attention. The income of the Smithsonian has not permitted the expenditure of much money upon this class of observations; but it hopes to secure the co-operation of interested volunteer observers. —*Smithsonian Report*, 1872, 40.

CLIMATE OF ALASKA.

The *Service Monthly*, in an interesting chapter upon Alaska, gives a few items regarding the weather which will be of interest to those who do not appreciate the peculiarities of that climate. At Sitka the mean temperature of summer is 54°, and that of winter is 32°, the latter being precisely the mean of St. Louis, Missouri. In place of incessant hail and snow, as is frequently erroneously supposed, rain falls throughout the winter season, and whatever snow falls soon disappears. Not only do these thermal conditions exist at the capital of Alaska, but a proportionally high temperature reigns throughout the coasts beyond, and the influence of the ocean currents extends even to Norton Sound, near the arctic circle. In the Aleutian Islands the winters are somewhat colder, but the temperature frequently remains above 35° until the 1st of January. On Kodiak Islands the two most severe frosts

of one winter were recorded at 0° and 13°. The Greek bishop, Veniaminoff, who has kept a continuous record for six years, states that during that interval only on nine occasions did the mercury fall below 10° Fahr.; but, on the other hand, the summer temperature averages only 49°, and the line of perpetual snow on Makushin, an active volcano in Unalashka, has an elevation of 3100 feet. The arctic winter in the interior at Fort Yukon yields a mean temperature of 30°, but the mean temperature of July is frequently as high as 65° or 70°. From December to April the average number of days on which rain or snow falls in the Aleutian Archipelago is twenty-six per month. The mean temperature of the winter months on the island of St. Paul is 20°, or very nearly the same as at Omaha and Northern New York. Fog prevails almost incessantly in the autumn. Iceland, in the North Atlantic, and St. Paul, in the North Pacific, or Behring's Sea, represent respectively two areas of low barometer.—*Service Monthly*, *December*, 1873.

THE METEOROLOGY OF ST. PAUL'S ISLAND, IN BEHRING'S SEA.

The Signal Service observer in Behring's Sea, Sergeant C. P. Fish, makes some interesting remarks concerning the meteorology of that region, from which we extract the following: A very extended area of low pressure prevails over Behring's Sea throughout the year, being remarkably low in winter, in which season, also, the variations of pressure are extremely great. The great depressions, or storm-centres, move forward at rates varying according to that of the cirrus cloud. The range of temperature is most intimately related to the extreme degree of humidity which prevails even through the winter months. In this respect the influence of ocean currents is particularly noticeable. The winter isothermal, of 20° Fahr., probably lies considerably south of this island. The warmest days are those preceding the easterly quadrant of storms moving northeastward. The winter maximum of temperature very rarely attains 40°. The minimum has never been known to extend below −14°, and rarely reaches −10° Fahr. The north wind is the least humid. Then follow the northeast, northwest, west, southwest, south, east, and southeast, which last is, therefore, the most humid. The northeast wind, therefore, corresponds remarkably to the northwest

wind of the eastern portion of the North American continent, and to the northeast wind of Western Europe. The velocity of the north wind is usually about 25 miles per hour, but frequently for days together it moves at the rate of 30 to 45 miles. The average velocity of the east-northeast wind is about 38 miles an hour, sometimes rising however to hurricane violence. The southeast wind seldom moves with a less velocity than 25 miles, and frequently rises to 70 miles, but averaging about 35. The southwest wind averages from 30 to 35 miles, occasionally rising to 70 miles. The greatest precipitation measured seldom exceeds 0.4 of an inch daily. On a large number of the days marked as rainy scarcely 0.1 of an inch falls. By far the greater amount of precipitation during the winter months is in the form of snow drifting immediately into the sea. The rain-drops are of comparatively small size. The hail is generally sleet. The storms prevailing during winter are divided into those coming from the west-northwest and those from the southwest; the former occur at any season of the year, but more frequently in the later months of winter; the southwest storms are those which impart to this sea its tempestuous climate; they assume their greatest frequency in November; their real origin appears to be in the China seas; their precipitation is frequently light, on account of the fineness of the rain or snow. In the southwest storms the barometric fall is proportioned to the rapidity of the approach, and storms of this class are of comparatively brief duration. After a number of observations on cirrus clouds at an extreme altitude, Sergeant Fish abandons, for the present, any attempt to demonstrate the possibility of a steady west-northwest current at great altitudes. The atmospheric conditions over Behring's Sea are particularly favorable for tracing auroral relations to storms. The aurora, whenever it appears, is of but very moderate intensity, and only under certain conditions is it visible at all, even through the clearest skies. The cloudiness, although extreme, is yet so frequently broken that but few nights pass without rifts in the direction of the magnetic meridian. Scarcely a single storm has passed the island during the winter unaccompanied by the appearance of auroral light. When the display appears through a sky free from upper clouds, Sergeant Fish states that he invariably anticipates the ap-

pearance of traces of the cirrus in the far west.—*Report of the Army Signal-office for* 1873, 446.

METEOROLOGY IN RUSSIA.

The last report of the secretary of the Smithsonian Institution contains a very complete review by Dr. Woeikof of the past and present condition of meteorology in Russia. He states that the first records kept in that country were made about the middle of the eighteenth century, according to various methods and with indifferent instruments. Attention was directed in the latter part of the century toward Siberia, but very little result has come from the observations that were then made. Between 1820 and 1825 there were about thirty observers, generally private individuals, throughout the entire empire. The great impulse given to the study of magnetism in 1828 by the founding of the Magnetic Union in Germany, and the influence of Baron Humboldt, first gave a great impulse to the study of meteorology in Russia; and eight completely equipped observatories were established between St. Petersburg on the west and Nertschinsk on the east. The magnetic observatories were reorganized by Kupffer in 1833, and were placed under the supervision of the department of mines. The results of the works conducted at these observatories were published under the title of "Magnetical and Geological Annals." The Russian Central Physical Observatory, at St. Petersburg, was founded in 1849, and had an important influence in elevating the standard of accuracy of the instruments employed throughout the kingdom. The schools of agriculture, and many other public institutions, as well as private individuals, volunteered to assist in the work. A great mass of observations by volunteer observers was collected and made use of by Vesselloffski in his "Climate of Russia," published in 1857. In this famous work, which is still the standard, the temperature tables are given for 147 stations, and tables of the freezing and opening of 140 rivers and lakes. For St. Petersburg the records run back through 167 years. The most important part of Vesselloffski's work relates to the winds. It was demonstrated that the climate of Russia has not materially changed since the days of Herodotus. The records of the opening and closing of the Duna River, at Riga, extend back to the middle of the sixteenth

century, and show a remarkably persistent uniformity in the climate during the last 300 years. Kämtz succeeded Kupffer as director of the Physical Observatory, and on his death Dr. Wild succeeded and still fills the office. Under Wild, the printing of the original data of observations has steadily gone forward, thus making them accessible to students of meteorology throughout the world.

This method of publication, though costly, would probably be adopted by all the governments of Central and Western Europe had not the expenditures for military operations increased so enormously of late years that the governments have become very economical in their appropriations for scientific purposes. Happily, Russia is now in a condition to devote more means to the cultivation of science and other useful purposes. It has been proposed to divide the extensive Russian dominions into smaller sections, the observers in each of which should look to some local establishment, university, or other institution as its centre. This method, at present, is in successful operation in the Caucasian provinces, which come under the direction of Moritz at Tiflis. The practical application of meteorology to public uses, of which the system of weather predictions so extensively used in the United States is an excellent example, so far from interfering with the progress of pure science, must, according to Woeikof, by extending the number of observations and increasing the number of men interested in the science, conduct to new discoveries. Those scientists are therefore mistaken who suppose that they can best advance their respective sciences by shutting themselves out from the world, unheedful of its claims upon them. The increase and diffusion of a knowledge of pure science and its practical application should go hand in hand.—*Smithsonian Report for* 1872.

WEATHER PREDICTIONS AT THE ISLAND OF MAURITIUS.

In regard to the system of storm-signals used in the island of Mauritius, Mr. Meldrum reports to the British Association that, in his opinion, it has been of considerable utility, but can be much improved by a better telegraphic communication with some of the other islands of the Indian Ocean. So far as his experience goes, he states that no hurricane has ever passed near Mauritius without ample warning having been

given of its existence and progress. He thinks that the issuing of distinct weather prophecies, in the sense in which that word is used in astronomy, would be quite premature; but that a statement of probabilities, such as has for many years been published by the French government, and lately by the United States, would be fairly proper.—*Monthly Notices of the Met. Society of the Mauritius*, 1873, 27.

UTILITY OF OCEAN METEOROLOGY.

Sir Francis Galton has presented some interesting meteorological statistics in connection with the solution of the question of using such data for the purpose of determining the best course for a ship whose sailing qualities are previously known. He states that if we desire to estimate which of two alternate passages between the same ports can be performed most quickly on an average of many voyages, no knowledge can be more immediately useful than that of the distance which the ship can accomplish at various points of the route in a unit of time. To obtain this knowledge it is necessary to know the average currents and winds, and especially the relative sailing qualities of the vessel according as it sails with the wind or on either tack. To deduce this latter and most important element in the calculation, Mr. Galton has invented a machine, in which, when certain parts are pushed forward, the points representing north, south, east, and west, respectively, move through distances corresponding to those over which the ship would sail toward those quarters of the wind, and by means of such a machine, or by proper arithmetical processes, a small chart is constructed, showing at a glance the sailing qualities of the vessel. This chart is to be laid upon each square of one or two degrees on the ocean's surface, and made to indicate such changes as are necessary to accommodate it to the winds prevailing in that region of the ocean. The result of this is that we have a map of the ocean, covered with small diagrams, each of which graphically shows the distance through which a given ship can be expected to sail during a unit of time—say, one day—in that region, under the known average conditions of winds and currents; and a very short study will show the navigator who finds himself placed in any portion of the globe, with a certain wind blowing upon his vessel, what sail to make in

order to move the most rapidly toward his haven. Mr. Galton considers that his idea can be put into practical use as well by navigators as by the closet student of meteorology, and that it will be found that no degree of precision of meteorological knowledge need be thrown away in the practice of navigation.—*Pr. Royal Society*, 1873, 270.

SIGNAL STATIONS IN THE DOMINION OF CANADA.

The Dominion government has established a series of stations for meteorological and storm-signal purposes in New Brunswick and Nova Scotia, which are to be put into telegraphic communication with the Signal Service Department in Washington, although the advantages accruing to the provinces will be much greater than to the United States. The proposed stations are, for New Brunswick, at St. John, St. Andrew's, Schediac, and Gaspé; in Nova Scotia, at Halifax, Pictou, Yarmouth, Sydney, Cow Bay, and Little Glacé Bay.

THE REDUCTION OF BAROMETRIC OBSERVATIONS TO THE SEA-LEVEL.

The recent publication, by Dr. Hann, of a short essay, in which he throws great doubt upon the propriety of the ordinary methods of reducing barometric observations to sea-level, and even virtually acknowledges that it is impossible to effect this reduction without introducing gross errors, has had the effect of drawing from Wild, of St. Petersburg, and from Jelinek, of Vienna, two most interesting and valuable statements of the reasons why they prefer to continue to adhere to the methods recommended by the Vienna Congress in 1873. The method proposed by Wild, which he states has recently been adopted by himself for all the Russian observations, is a somewhat peculiar mixture of three different methods adapted to three different classes of meteorological stations, and if we rightly apprehend the objections that he urges to Dr. Hann's propositions, they amount simply to this: that the so-called deviations between the individual and the normal values of barometric pressure require themselves to be reduced to sea-level, although this at present is rarely or never thought of, and that in this reduction errors would necessarily be introduced perfectly comparable in their importance to

those incident to the best methods of reducing the barometric pressure itself. The methods proposed by him are evidently applicable, within moderate limits of error, only to such systems of observation as are in vogue in Europe, where but one daily report is sent to the central station, and are to a far less degree applicable to the system of tri-daily observations carried on in the United States.—*Jelinek*, *Meteor. Zeitschrift*, IX., 113–121.

REMARKABLE BAROMETRIC DEPRESSIONS IN ENGLAND.

Marriott has given an account of a remarkable barometric depression that occurred on the morning of the 24th of January, 1872, all over Great Britain. In several portions of England, where the barometer is said seldom to fall to 28.7 inches, the pressure was observed to be 28.2 inches. The atmospheric phenomena attending this depression have been specially investigated, at the request of the Council of the Meteorological Society of London. The depression appears to have touched the coast of England near Falmouth about midnight, and to have passed along the coast at the rate of thirty-seven miles an hour until 3 A.M. of the 24th, when it took a northerly course, reaching Birmingham at 6 A.M., the rate of progress being about forty miles an hour. It then moved north-northeastward at the rate of thirty miles an hour, until 9 A.M., traveling across England at a faster rate than when moving along the coast. It passed over the mouth of the Humber, and beyond the reach of English observers, between 10 and 11 A.M., its general course having been northeast by north, at the average rate of about thirty miles an hour. On the east and southeast sides of the depression the force of the wind was much greater than on the opposite sides, but the barometric gradients were much steeper on the western than on the eastern sides. The gale was one of the most violent that had been experienced for a considerable period, many lives being lost, and much damage done to property and shipping. In order to find analogous instances of depressions, in this portion of England, it is necessary to go back for a number of years. There are only four on record in which this depression has been exceeded: viz., in 1791, 1814, 1821, and 1843; and in these the lowest recorded barometers were respectively 28.15 inches, 28.32, 27.93, and

28.20. In the discussion which ensued on the presentation of Mr. Marriott's paper, Mr. Scott stated that among the extraordinarily low readings of the barometer should be remembered that of the 5th of February, 1870, when 27.33 had been recorded on board the Cunard steamer *Tarifa*, while, in 1839, Dr. Knight, at Aberdeen, recorded 27.56, and in 1828, on the 28th of November, Dr. Robinson, of Armagh Observatory, had recorded 27.61. On this latter occasion the barometer readings at Dublin had ranged below 28 inches for twenty-four hours, and, as might be expected with such an extensive depression, there had been no storm. Mr. Burt also remarked that great depressions of the barometer had occurred about the middle of January during the last five years.—*Quar. Jour. Meteor. Soc., London*, 1873, 190–220.

THE NOVA SCOTIA CYCLONE.

Captain H. Toynbee presented to the Meteorological Society of London, at its last meeting, a short account of various data which have come into the meteorological office of the Royal Society respecting the storm which was so disastrous in its effects on the coast of Nova Scotia, and, indeed, along its entire path over the Atlantic Ocean. The most interesting portion of Captain Toynbee's remarks was based upon the report of Lieutenant M'Farlane, of her Majesty's steamer *Plover*. This gentleman states that if the circular theory were correct, there was nothing left to investigate in reference to this hurricane, excepting to trace its progress from the formation to its breaking up; but if the ideas promulgated in Mr. Meldrum's note on the form of cyclones in the Southern Indian Ocean were correct, then it was incumbent on the meteorologists of the northern hemisphere to institute a similar inquiry, since there would then necessarily result a modification of the rules in use among seamen for avoiding the severest portion of the cyclonic storms. The author expressed the hope that all data in reference to the Nova Scotia storm may be collected, either by American or English meteorologists. This suggestion, it may be remarked, has already been anticipated by the action of the Army Signal-office, as will be seen from the extended report on this storm drawn up by Mr. Abbe, and printed in the annual report of the Chief Signal Officer.—12 *A*, 1873, 155.

THE CALCUTTA CYCLONE OF 1872.

In June, 1872, there passed over the Bay of Bengal one of the most memorable cyclones that ever occurred in that region. The importance of predicting such storms had long since attracted the attention of the government of Bengal, and it was considered the duty of the meteorological reporter to give prompt information of the approach of destructive cyclones to the harbor of Calcutta. But the unsatisfactory nature of his relations to other officials seems to have prevented the successful prediction of the storm in question, which was very destructive, and especially so by reason of the tremendous sea. The officiating meteorologist to the government of Bengal was, after this, directed to prepare a special report upon this storm, with such suggestions as he deemed necessary for perfecting a system of storm signals in that region. From this report, which is now before us, and which has been very widely distributed throughout the world, we see that the storm was one of very small compass, apparently generated in the Bay of Bengal. For some time after its formation it seems to have been almost stationary, and subsequently moved with a velocity of about ten miles an hour. Subsidiary vortices appear to have been formed, and afterward broken up. The report states that storms generating in the north of the bay so late in the season seldom possess sufficient energy to travel inland, and generally burst up or disperse when they come in contact with the land. The comparatively limited sea-room seems to have prevented the carrying out of those rules which have been laid down by Colonel Reid and other writers on revolving storms; and in this connection one is surprised to notice the statement made by the committee of the Bengal Chamber of Commerce to the effect that most pilot vessels sailing out of Calcutta do not possess chronometers, and generally have to trust to any stray ship that they may come across to give them their latitude and longitude.

Among the valuable results of the publication of this report, we notice the excellent rules given in it for the navigation of vessels, and the general indications of the probable formation of a cyclone. American vessels sailing to this region will find it well to bear in mind the following: "Ships

coming up the Bay of Bengal in the months of May and June, with fresh southwesterly gales, accompanied by torrents of rain and falling barometer, should not press northward until the weather improves, and the barometer rises steadily." And again: "In order to find the bearing of the centre of the cyclone, lay to and watch the barometer and wind, stand with your face to the wind, and measure round to your right-hand side about ten points." (In the southern hemisphere the ten points should be measured round to the left.) Daily telegraphic weather reports are considered to be desirable from six points, mentioned in the report; and signals are suggested of three kinds—first, a cautionary signal, indicating that bad weather is probable; second, a warning signal, indicating that a cyclone is probably in the course of formation in the bay; third, a storm signal, indicating that a vortex has been formed, and is probably approaching. The telegraphic connection with the observing stations has been hitherto quite uncertain, especially in stormy weather, when most needed—a matter which seems to have been remedied, weather reports now having the priority over all other messages in the telegraph office.—*Report of W. G. Wilson to the Government of Bengal.*

THE WINDS OF NORTHERN INDIA.

Mr. Blandford, of Calcutta, has presented a paper to the Royal Society on the winds of Northern India, his intention being to trace out the origin and causes of the normal wind currents, and their annual variations, so far as can be discovered. Among other things, the author states that the vapor in the atmosphere indirectly greatly influences the barometric pressure by carrying heat from the lower to the upper strata, and by arresting solar and terrestrial radiation, thus equalizing the temperatures of the column of air; but that the influence of vapor in changing the density of the atmosphere, by reason of the displacement of the heavier air particles, is relatively small, and in some cases unimportant. In general terms, the changes of temperature are the principal causes of the variation of pressure. Inquiry is made as to whether any dynamic heating or cooling of the air can be traced, as is maintained by some must occur, when winds descend to a lower or rise to a higher level; but Blandford

concludes that no such effects are discernible, and that certain explanations of the winds of India, as based on such a conception, are erroneous. Evidence is adduced to show that anti-monsoon currents blow in the upper strata of the atmosphere at the various seasons of the year and at varying elevations, causing corresponding modifications in the general temperature; the operation of all winds being to distribute the temperature peculiar to them. To the descent of the anti-monsoon current from the south the author is disposed to attribute the rains of the cold season. Attention is also directed to the velocity of the wind currents near the sea; the westerly winds increasing in force as they approach Bengal, and the southeasterly winds diminishing in force as they reach the northwest provinces; indicating that the descending and ascending currents must be formed in the upper strata, though of the return southward of any descending current from the north there is no direct evidence.—*Proc. Roy. Soc.*, XXII., 218.

THE WINDS OF INDIA.

In an article on the climate of Bengal, by Blandford, of Calcutta, he states that the wind system of Bengal, although often described, is yet very generally misunderstood, at least as regards the character and origin of the monsoons on the land. These are not two undivided currents flowing to and from Central Asia during the winter periods of the year, but appear rather to consist at each period of two principal currents, one tending to or from Northern India, the other to or from the interior of China; and there are probably two or more minor currents, originating or terminating at their centres. The winter branch of the monsoon originates in the plains of the Punjab, the valley of the Ganges, and the uplands of Central India, and blows as a very gentle wind toward the two great bays that wash the east and west coasts of the peninsula. During this season a southerly wind prevails steadily on Himalaya, at heights above six or eight thousand feet; this appears to be the upper return current of the winter monsoon, and corresponds to the anti-trade of the trade-wind region. It descends on the plains of Upper India, where the atmosphere is characteristically calm at this season, and brings the winter rains. In a subsequent part of

Mr. Blandford's article, speaking of the severe cyclonic storms, he states that the highest wind that has yet been registered in Calcutta gave a pressure of fifty pounds to the square foot; but this was a storm of no remarkable violence, and which did little injury in that city. There is a prevalent impression that cyclonic storms have been more frequent of late years than formerly; but this idea is more likely to be a consequence of the increased attention given to the subject, since in recent times every storm that occurs is fully noticed, with all procurable data, in the meteorological reports.—*Proc. Asiatic Soc. of Bengal*, 1873, 178.

THE TORNADO OF MAY 22, 1873.

The very thorough report of Sergeant McIntosh, of the Signal Service, on the severe tornado experienced in Iowa and Illinois on May 22, 1873, affords us the following facts, condensed from the forty pages of detailed observations given by him:

An area of low barometer existed in the Mississippi and Missouri valleys from the 20th to the 22d of May, moving very slowly northward. This induced a southerly warm current over a large portion of the interior of the continent. The result was a series of violent local storms, generally accompanied by hail, and always by lightning. They reached a climax in the tornado which is the subject of this paper.

A huge dark cloud covered an area of at least thirty miles in diameter. Under the southwest edge of this cloud was observed a perfectly opaque, funnel-shaped appearance, reaching from the ground to the clouds; toward its base the wind, in spirals, rushed violently from all sides, overthrowing whatever opposed its progress; toward its summit, where it disappeared in an overhanging horizontal cloud, long streaks of clouds rushed, in spirals, from all directions. Under the remainder of the main cloud, which lay chiefly to the northwest of the rising column, there raged a tremendous storm of hail and rain, accompanied by incessant electrical phenomena. The summit of the dark cloud is computed to have been fifteen miles above the earth's surface, its horizontal diameter being at least thirty miles, as before stated. The under surface of the cloud was less than three miles in altitude at one point, and at another point scarcely half a mile. The

current of air flowing from all directions toward the central funnel had a horizontal diameter of at least twenty miles at the surface of the earth, and probably ten miles at the altitude of the lowest clouds. The diameter of the funnel at the surface of the ground varied from fifty to seven hundred yards. Its form could be distinguished up to the height of between one and two miles by observers who were favorably situated. The vortex of extreme violent winds varied from nothing to one hundred yards, having an average diameter of about thirty yards. Although the preceding dimensions of the funnel are deduced from more or less reliable observations, yet Sergeant McIntosh concludes that, in view of the optical delusions incident to such observations, he is justified in considering that the height of the funnel was, at the very utmost, only a few hundred feet. Some observers saw only one funnel; others saw two funnels superimposed with the two narrow ends together, while a good many saw two and even three funnels side by side. The evidence on all these points is beyond question. He considers that, in general, the smaller and lower end of the funnel moved onward in a very irregular manner, and, on the average, lagged behind the advancing cloud overhead; new centres of condensing vapor, and of consequent rarefaction of the air, were continually forming in advance of the moving funnel, so that new funnels were formed near the surface of the earth, and joined themselves to the cloud above, while the lower end of the old funnel was dissipated, thus giving rise to an apparent swaying of the funnel, from side to side, and forward and backward. The tornado traveled in an east-northeast direction, varying its course, however, every few miles, according as it neared lakes, rivers, or open fields. Its average velocity of progress appears to have been about twenty-nine miles per hour. The wind blew in spirals to the centre of the vortex; the direction of revolution being contrary to the hands of a watch throughout the whole course of the storm. All who saw the funnel unite in describing it as circular, and whirling in the direction described. Besides its horizontal motion, the wind had necessarily an ascending motion. At one place the angle of ascent was about 45°. In the black funnel itself the inclination was at least as great, and probably greater. Twenty-six well-defined cases are

adduced in which it is possible to calculate the pressure exerted by the wind. The most reliable results attained give pressures varying from forty to two hundred and thirty pounds to the square foot, which correspond to velocities of from ninety to two hundred and fifteen miles per hour. There were no rain-gauge measurements of the amount of rain in the immediate path of the tornado; but, from the accounts given, McIntosh estimates that two inches of rain fell over an area of ten miles in width. No cases were found of unmistakable explosion from the expansion of air contained within closed areas; and, indeed, the observer shows that, in all the cases in which houses were burst asunder in every direction, this result is to be attributed to the violent wind striking against their doors and windows, and pressing inward. The whole interior of the building thus became subjected to a strong pressure, due to the pressure of the air; the pressure was more than balanced on the side struck by the wind, while on the other side there was nothing to resist it, and the house was burst asunder. Some houses were evidently thrown, bodily, across the centre of the tornado, and then struck by a contrary wind and shattered into fragments. The temperature at the centre of the storm is very generally described as having been decidedly cold, and is assumed with some reason to have been about 13° below the average temperature on the surface of the ground, as shown by the Signal Service charts. The barometric pressure at the centre of the funnel is computed by Mr. McIntosh at 15.7 inches. This computation, however, is based upon the well-known formula derived from the mechanical theory of heat, and is subject to considerable uncertainty. The sound made by the conflict of winds in the tornado was tremendous, and drowned all other sounds. A man could stand by his house as it was shivered to pieces and not hear the noise of its breaking. A number of observers heard the roar at a distance of sixty miles, like the roar of the ocean or the thunder of the battle-field. Comparing this with the sound of cannonading or the eruption of a volcano, the author writes that "the voice of the tornado is, therefore, one of the strongest known to art or nature." The violent winds experienced at the centre of the storm evidently prevailed to a great distance from the centre, since numerous heavy ar-

ticles were carried from one to four miles, and doubtless even farther. The hail that fell at one place contained fragments of grass, leaves, and particles of sand. This hail generally preceded the rain.—*Annual Report of the Army Signal-office for* 1873, 1046.

THE CHANGE OF TEMPERATURE WITH ALTITUDE.

Mohn, the well-known meteorologist, in an interesting disquisition on the distribution of temperature in the neighborhood of the city of Christiania, takes occasion to make some general remarks on the change of temperature with the altitude, which are of very general value; as, indeed, is the entire essay. This change, as he states, depends upon a number of causes. He says that the diminution of temperature, with the elevation above the earth's surface, is a consequence of the rising and falling of masses of air, and is modified in various ways by local causes, which can equally increase or diminish the local temperature at great or slight altitudes. The transportation of a mass of air from a lower to a higher level, or the reverse, is most easily accomplished when the air is in rapid motion along the surface of the earth, whose inequalities it is forced to follow: in other words, the ascending and descending movements of the air accompany the strong winds. The diminution of temperature with the altitude, so far as it depends upon ascending or descending currents, is most easily brought about when winds of considerable strength blow. In very quiet air the strata of the atmosphere can, possibly, arrange themselves in a manner that does not always correspond to their respective temperatures and density. The most rapid diminution of temperature with altitude, as well as the greatest precipitation of rain, occurs with winds that are stronger than the normal winds. The rate of diminution increases when the air is very dry. In these cases the radiation of heat is in general stronger, and is greatest at the highest level, where the air is thinner, and the mass of aqueous vapor smaller. The rate of diminution of temperature diminishes, or even is turned into an increase, with the altitude, in the colder portion of the year, under the following circumstances: If the temperature sink below the normal, and the pressure of the air in the interior of the continent rise higher than on the coast, there follows a cold pe-

riod; the greater cold in the interior of the land causes a strong contraction of those strata of the air that lie nearest to the earth's surface, whereby the atmospheric pressure is increased. The increased pressure forces the air from the interior, outward, toward the coast, causing the land winds. The cold, dense air that streams outward from the continental areas of barometric maxima seeks the valleys, on account of its greater density, and over these it pours with a slight velocity, as a river flows into the sea. The moisture that rises from the warmer earth's surface is not dissolved by the cold air, and forms fog in the valleys; while the higher portions of the country enjoy clear sunshine. Under these circumstances, the higher portions of the mountains enjoy a temperature that is dependent upon the quantity of solar heat received, while the valleys experience a cold air that is really foreign to them, being brought to them by atmospheric currents from a great distance. These principles are very successfully applied by Mohn to the explanation of a number of observations, made at various altitudes, in the neighborhood of Christiania; and the principle has long been familiar to the American readers of the predictions of the Army Signal-office. The latter institution has, we believe, never failed to predict the cold northers of Texas and the Gulf States.—*Jelinek. Zeitschrift Met.*, IX., 97.

THE TEMPERATURE OF THE CLOUDS.

The temperature of the clouds has been investigated by Professor Poey, who has employed for this purpose the thermo-electric pile. Professor Henry, secretary of the Smithsonian Institution, was, we believe, the first to apply this instrument to a similar object; but the results obtained by Professor Poey appear to be more positive and definite than any that have been hitherto published. He has shown that the cumulus and the cumulo-stratus of summer are the clouds of highest temperature; then follows the fracto-cumulus, except when it comes after the rain which accompanies the thunder-storm (in which case it is of a whitish color, very rapid in its motion, much torn at its edges, and partaking of the low temperature prevailing on such occasions). The cirro-cumulus is colder than the cumulus, and the cirrus is the coldest of all the clouds. It has during the last few years

come to be generally understood, at least by those government meteorologists who are engaged in weather predictions, that the most important element of success in this branch of meteorology is a better knowledge of the vapor of the atmosphere in all its various states and changes. This science will, indeed, not make the advances it is designed to make until meteorologists generally recognize the necessity of equipping their first-class observatories with the requisite appliances (both instruments and physicists) for carrying on those physical researches which are intimately allied to their own science.—12 *A*, IX., 164.

THE TEMPERATURE OF ST. PETERSBURG.

Rikatcheff has undertaken the laborious work of applying to the observations of temperature at St. Petersburg the method of computation which enables the daily rate of change of temperature to be represented by the simple harmonic formula frequently known as Bessél's. To this end Rikatcheff has employed the observations of twenty-one years, ending in 1862, and made during the greater part of this period for each hour of the day. He has studied the interesting question of the rate of change of temperature in cloudy and in clear weather—a refinement that has, perhaps, never been introduced on so extensive a scale as he has had the opportunity of doing. For St. Petersburg, he finds that there is most cloudy weather in the month of December, and most clear weather in July and August: a rule that Wild has shown to be true for nearly the whole of Russia. The maximum cloudiness in November and December is about 72 per cent.; the minimum in June and July about 42. When the sky is clear, the daily increase of temperature is a maximum in May; while the nightly decrease is a maximum in December. The days when the daily increase and the nightly decrease are nothing are in March and September. When the sky is covered with clouds, the value of the diurnal change is found to vary regularly with the seasons, but depends, in general, on rules such as the following: In spring, the temperature does not increase, but rather diminishes; in winter it increases. The greatest cooling occurs in the month of June, and the greatest diurnal increase of temperature in the month of December. These striking phenomena are ex-

plained easily by recollecting that the clouds form a sort of covering above the surface of the earth, preventing its cooling in the winter and its warming in the summer. And, again, the clouds come generally from the adjacent ocean, and bring with them in winter a temperature warmer than the interior of the continent; therefore in winter a clear, cool day is followed by a cloudy, warm day; and the observations show that if, during the whole year, the heavens remained covered, the mean annual temperature of St. Petersburg would not change from year to year. In order to predict the minimum of temperature with some probability, it is necessary to take into account the consideration of the humidity of the air, for if it happen that, with a clear sky, the atmospheric humidity is considerable, then in the evening, when the temperature lowers, the vapor may condense, and its latent heat become free, and delay the fall of temperature. The minimum temperature during the night is generally but very little different from the temperature of the dew-point as observed the previous evening. — *Wild's Repertorium für Met.*, vol. iii.

THE MEAN TEMPERATURE AT HELSINGFORS.

The great toil attending the careful reduction of a series of observations, extending over many years, renders it always a pleasant task to note the completion of so laborious and so useful a work as that recently published by Krueger, who has endeavored, for Helsingfors, to extend the work performed a long time ago by Hallstrom. The observations made at the Magnetic Observatory at Helsingfors, during the years 1848 to 1856, were recorded every twenty minutes, and give one a very complete insight into the daily variation of temperature, and the times of maxima and minima, together with their relation to the mean temperature. This mass of material has been partially reduced by Nordenskjöld, and Krueger has completed the work by determining the co-efficients of the harmonic series by which it is customary to represent the average temperature of any station. He finds that the results of sixty-eight years of observations may be represented within an error of less than one thirtieth of a degree Centigrade, by a formula in which the sines and cosines of the first, second, third, and fourth multiples of the temper-

ature occur. The comparison between Krueger's formula and that determined by Hallstrom, for the eleven years ending 1839, shows important constant differences, which Krueger attributes partly to the fact that the two series of observations were made in two entirely different localities, and partly to the fact that the series used by Hallstrom was not so complete as that of Krueger.—*Krueger on the Mean Temperature of Helsingfors.*

RAIN-FALL ON THE ISTHMUS OF PANAMA.

We can form very little idea in our temperate latitude of the amount of rain which falls in various tropical regions of the world, and especially on the Isthmus of Panama. According to a recent article in the Panama *Star and Herald*, the amount of rain-fall in 1871 was about 100 inches; but in 1872 it reached the enormous quantity of 170 inches, or something over fourteen feet. The most rainy month on the Isthmus is October, and the least is April. In the mountainous portion of Central America, during the month of October, the day dawns clear over the sea, but is cloudy along the tops of the distant Cordilleras, the wind blowing fresh from the southwest; but at mid-day the mountains are covered with clouds, and a pouring rain begins to be precipitated from them at 2 P.M. The waters deluge the plains, and extend to the sea-coast in a flood. The thermometer generally falls during the rain from 84° to 80°, or to 79° Fahr. It is asserted that the rains were formerly much heavier even than now, so much so, indeed, that for the month of October the people laid in provisions and firewood for two weeks. It has been noticed, on parts of the Isthmus, that the change from the wet to the dry season, and *vice versa*, is apt to be attended by slight earthquake shocks.

SELF-RECORDING RAIN-GAUGE.

The success of Professor G. W. Hough, of the Dudley Observatory, in constructing self-recording barometers and thermometers, lends additional interest to his announcement of the successful construction of an automatic evapometer and rain-gauge. The apparatus consists of a vessel two feet square and one foot deep, suspended on levers, and held in

equilibrium by a small spring, the amount of change in the weight of the mass, either from rain-fall or evaporation, being indicated on the scales of a delicate balance. In order to secure the mechanical record of the hourly variations in the weight of the vessel and of its contents, the professor causes the lever to vibrate between two platinum points so placed that whenever a change in the weight of the vessel by a given amount (say ten grains) takes place a magnetic circuit will be established, passing through an electro-magnet. A micrometer screw will then be operated by means of clock-work, thereby tracing a curve on a revolving drum, precisely as in the case of the self-recording barometer and thermometer.—*Proc. Amer. Assoc.*, 1873.

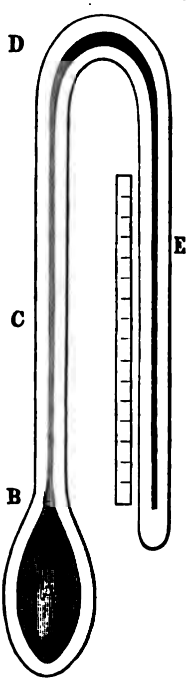
JOULE'S NEW BAROMETER.

Dr. Joule, of Manchester, describes in the proceedings of the Literary Physical Society of that city the method of construction of a new barometer. The tube of this instrument has a bore of about three sixteenths of an inch, is bent into a siphon shape, and near the longer end is drawn to a capillary tube. After having been thoroughly cleaned with nitric and sulphuric acids, the short end of the tube is filled with mercury, the end of the longer limb being attached to the mercurial exhauster, an instrument apparently on the principle of the Sprengel air-pump. On working the exhauster the mercury rises in the long tube of the barometer, and being replenished by pouring more into the short limb, the longer column soon rises to the height due to the atmospheric pressure. The acid left adhering to the inside of the tube accumulates on top of the longer column of mercury to the depth of one third or one half of an inch. All bubbles of air or other gases disappear in the course of two or three days. The capillary part of the tube is at length sealed, and the barometer is complete, a small quantity of sulphuric acid being added to the shorter end of the tube. Mr. Joule states that the instrument thus formed has the utmost facility in its movement, so that the most minute changes of pressure are registered without any dragging. The depression produced by capillary action is reduced by one half.

THE NEW DEEP-SEA THERMOMETER.

The thermometer recently invented by Messrs. Negretti & Zambra, for the self-registration of the temperatures of the water at the bottom of the ocean, is one of such novel construction, and withal of such universal applicability, that it merits a special notice. Hitherto, the registration of deep-sea temperatures has principally been made by means of Six's minimum thermometer, or else by means of metallic thermometers, both of which instruments are liable to serious derangement; and, worse than this, although these thermometers register a minimum temperature, yet there is always a grave uncertainty as to the depth of the stratum of water at which that temperature is obtained. The new instrument would be described in a general way as consisting of an ordinary thermometer having a very long tube, the upper half of which has been bent over, producing the shape of a siphon, or an inverted U. The frame to which the thermometer tube is attached is pivoted in the centre, and attached to a short length of wood or metal provided with a rudder or fan, and the whole apparatus suspended vertically on the deep-sea line. This fan or rudder, pointing upward as the thermometer is carried down through the water, preserves the instrument in its original or normal position; but the moment the line is drawn up and the instrument commences to ascend, the rudder reverses its position, turning the thermometer over into the inverted position, U, and then quickly completes the turn, and resumes its normal state as ∩. When the thermometer is thus turning, the mercury in one leg of the ∩ separates at a point determined by a glass plug, and the upper portion flowing into the other leg remains detached until the instrument is brought to the surface, where its length can be measured, indicating the precise temperature of the stratum of the sea in which the upset took place. The new instrument is guarded from the influences of deep-sea pressures by an outer case of glass, as was done by this eminent firm of instrument-makers many years ago with other apparatus for the Meteorological Department of the Board of Trade.

The wood-cut shows the position of the mercury after the instrument has been turned on its centre. A is the bulb; B is a small glass plug within the tube, and which, in the mo-



ment of turning, cuts off the mercury in the column C from that in the bulb A, thereby insuring that none but the mercury in the tube can be transferred into the indicating column E. D is an enlargement made at the bend of the tube, so as to enable the mercury to pass quickly from C into E. E is the indicating tube, or thermometer proper, with its scale of degrees. In the act of turning, as soon as the thermometer is put in motion, and immediately that the tube has acquired a slightly oblique position, the mercury breaks off at the point B, runs into the curved and enlarged portion, D, and eventually falls into the tube E, when this tube resumes its original perpendicular position. We believe that this thermometer will prove to be of great value on land; for with it we are at once provided with the means of making observations which will solve some of the most interesting questions connected with atmospheric temperature. By means of an inexpensive time-piece, an instrument of this kind may be made to turn over automatically at any hour that it is desirable, and the record can subsequently be read at the observer's convenience. Twenty-four such thermometers, so placed as to be successively inverted at the beginning of each hour of the day, will give us a perfectly definite and reliable hourly record of the temperature.—*London Standard, April* 7, 1874; and 12 *A*, 1873, IX., 387.

ANEMOMETRY.

The eminent Cavallero has contributed to the science of anemometry an apparatus for experimental determination of some of the important data which are needed in order to properly use the instruments that have been adopted in measuring the velocity of currents of wind, or gases in general. This apparatus has been constructed in the engineering school at Turin, and, according to the description given in the me-

moirs of the Academy of Sciences of that city, it consists essentially of a pedestal, from which arises a vertical iron shaft carrying a very long horizontal arm, at any point of which the anemometer, to be examined, may be placed, being held firmly by appropriate clamps. The length of this horizontal arm is about seven feet. Its weight and that of the instrument are counterbalanced by an adjustable counterpoise, and the whole is made to revolve rapidly for any desired length of time. The vanes of the anemometer, being set in motion by the resistance of the air, record their revolutions electrically by appropriate wires upon a chronograph placed conveniently near to the apparatus. In the formula for the reduction of the observations, allowance is made for the centrifugal force, and for the circumstance that the instrument is in motion while the air is sensibly at rest. So far as the density of the air is concerned, account is taken, not only of the barometric pressure, but of the moisture and temperature, and, apparently, every refinement is introduced into the calculations that can be suggested by the most critical mind. The two anemometers upon which observations have been made are those of Robinson and of Negretti & Zambra, or the so-called whirling-machine, the former being the hemispheric cup anemometer. As is well known, the former instrument is now rapidly supplanting all others for the purpose of meteorological observations, and it is usually assumed that the velocity of the hemispheric cups, as they revolve in circles about the axis of the instrument, is 0.33 the velocity of the wind. Cavallero's observations show that within the range of his experiments the number 0.36 should replace the value ordinarily assumed, but that it is subject to a comparatively large change, depending upon the velocity itself; a result that has been remarkably corroborated in the recent investigations of Phillips, in England.—*Atti della R. Accad. Scienze, Turin*, 663.

A UNIVERSAL METEOROGRAPH.

A very interesting meteorograph, or instrument for recording graphically the state of the barometer, thermometer, and with other meteorological features, has been described before the Academy of Sciences, Brussels, by Professor Van Rysselbergh; and the following report concerning its merits has

been made by a proper committee: "The problem that Professor Van Rysselbergh has endeavored to solve can be stated in the following manner: It is desired to make an apparatus, simple and inexpensive, in which a single graver shall engrave upon a single cylinder the indications of a great number of meteorological instruments of any nature whatever, and these either close together or at a distance from the recorder. The author has resolved this problem by modifying, in a very original manner, the apparatus originally described by Wheatstone. A vertical cylinder controlled by a clock makes, at equal intervals—for instance, every ten minutes—one revolution around its axis; a telegraphic circuit, of which the instrument to be observed makes a part, is closed by the movement of the cylinder; there is thus set at liberty a graver which touches the surface of the cylinder, and marks thereon perpendicularly to the generatrix a line whose length is proportional to the indication of the instrument in question; at each revolution of the cylinder the graver descends a small distance, so that we obtain a series of equidistant marks, the extremities of which form the curve of the observation. The cylinder is covered with a thin sheet of copper, smeared with a little grease, and when this sheet has received the inscriptions of the graver it is withdrawn and plunged into an acid, so that it thus becomes an engraved plate, from which one can print copies at will. The plates that accompanied the memoir of Professor Van Rysselbergh had been obtained by this process, from which the simplicity and precision of the instrument could be appreciated. The committee have reported favorably upon the idea of Professor Van Rysselbergh, and commended his invention to the approbation and encouragement of the Belgian government.—*Bull. Acad. Brussels*, 1873, 124.

LOW WATER IN THE RIVER SEINE.

Messrs. Belgrand and Lemoine predicted, four months in advance, an approaching stage of very low water in the River Seine, which would probably occur about the middle of October. In making this prediction, they desired to say that even though the summer months should be quite rainy, yet would the flow of water not be sufficiently great to disprove the truth of their prediction. It has been established,

in fact, that the rains of the warm months are but slightly, if at all, useful in regulating the flow of the river waters, because of the large evaporation which carries off the greater portion of the rain-fall. Their own observations have, in addition, shown that whenever, toward the end of May, the head-waters of the Seine have been very low, this deficiency is never made up until after the middle of October. The records of the past one hundred and twenty-five years show that the stage of highest water has varied in the spring-time, between February and March; and, in general, the relations of the river-flow to the surrounding country are such that while they could not attempt to predict any thing with regard to the character of the weather during the coming summer and autumn, they were confident as to the truth of their prediction with regard to the river-flow, and certainly expected that by the middle of October the River Seine would exhibit one of the very lowest stages that has ever been recorded.—6 *B*, LXXVIII., 1528.

THE FORMATION OF ICEBERGS.

On the formation of icebergs, G. C. Laube, of the German polar expedition, writes as follows: There are certain glaciers that occur on the east coast of Greenland which have received the very well-merited name of Puisootok. This Greenland word indicates places where the ice breaks up out of the sea, or where a glacier pushes its ice along under the surface of the sea until its advanced portions, being broken off, rise to the surface as icebergs. These glaciers are all distinguished by very great breadth and a very gentle angle of descent. Icebergs are found in their neighborhood such as never occur in West Greenland, wedge-shaped or rounded, with steep edges. They are, at the upper ends, pointed and dome-shaped, very dense, and rising, according to accurate measurements, to a height of two hundred feet above the surface of the water, with a correspondingly great circumference. This kind of iceberg is very distinct from the cracked and jagged ones that are formed from the abruptly ending glaciers, and equally distinguished from those that are formed from flat glaciers, whose strata project over the water. Laube thinks that those grand glaciers which shove in front of them icebergs having heights of six to eight hun-

dred feet, measured from the bottom, have not been formed in the same way as those which are broken off from an ice-sheet one or two hundred feet thick, but that the glaciers which originate the great icebergs have almost entirely the character of the great glaciers that covered Norway during the glacial epoch, and scraped out the fiords, and that, by reason of their great dimensions, they must necessarily have been shoved out under the surface of the sea.—7 *C*, 1874, 248.

INFLUENCE OF OCEAN CURRENTS ON TEMPERATURE.

Professor Mohn, of the Meteorological Observatory of Christiania, has been paying much attention to the relation between the temperature of the air and that of the ocean, and also to the influence of the currents of the sea as affecting the temperature of the sea-surface and that of the adjacent coasts. As a general rule, he finds that the water is remarkably cold where there is a current running in a sound; but where there is a broader sheet of water, and where the surface presents no trace of a current, the temperature is higher. Also that the temperature is higher the deeper the fiords penetrate into the land, or the farther from the open sea the observation is made.

The cause of this greater coolness of narrow surface currents is supposed to lie in the fact that in this case the water wells up from the bottom so as continually to bring a fresh exposure to the air, the bottom temperature, of course, being much colder than that at the top. In certain instances, too, the temperature as noted at the stern of a vessel was found to be lower than that at the bow, in consequence of the stirring up of the lower strata by the screw of the steamer from which the observations were made.

Although he has not had an opportunity of testing the question by direct experiment, Professor Mohn is under the impression that the temperature of the surface currents in winter is warmer than that of quiet water, owing to the fact that the stratum immediately in contact with the air is likely to be cooled below the mean of the upper layers of water. Compared with the temperature of the air, the water in summer, according to Professor Mohn, decreases at an average of about one degree Fahrenheit for each increasing depth of a fathom; but in winter it increases only at an average of

one tenth of a degree to the fathom. In summer the surface strata are thus highly superheated, while their cooling in winter is very feeble. These relations correspond exactly with the tendency of the water to arrange itself in strata of equilibrium, with the least dense layers at the surface.

The general conclusions at which Professor Mohn arrives may be summed up as follows: first, that the surface of the sea in currents in narrow sounds in summer is colder than in neighboring places where there is a wider sheet of water; second, that an effect of the reverse kind takes place in winter, but to a much feebler degree; third, that both effects together diminish the yearly range of the temperature of the surface of the sea; fourth, that these circumstances influence in the same direction the temperature of the air over such seas and sounds, and that hereby a part of the anomalous strongly marked oceanic character which places in such situations exhibit is accounted for.—*Jour. Scottish Meteorol. Soc., October,* 1873, 73.

THE TIDES OF TAHITI.

In 1856 the United States Coast Survey obtained a series of observations of the tides of Tahiti, which showed a remarkable peculiarity; namely, that the solar tide is for the most part greater than the lunar tide. Professor Ferrel, in discussing these tides, has shown that this peculiarity is not the result of any exception to the general theory of tides, as has sometimes been supposed; but that certain constants in the tidal expressions, which have to be determined by observations, are unusual in this case. There is one other instance of the kind known. It is impossible as yet to specify what are the irregularities in the bottom of the ocean and in the adjacent coast which occasion the phenomena; but that they are due to such irregularities seems unquestionable. — *New York Daily Tribune, April* 25, 1874.

THE DEPTH OF THE PACIFIC OCEAN.

Recent soundings in the eastern part of the Pacific Ocean indicate that its bed is singularly level. The United States steamer *Tuscarora*, having finished its first cruise between Cape Flattery and Unalashka, as well as between Cape Flattery and San Francisco, has recently completed a survey from San

Francisco to San Diego. Its results may be stated in general to show that along the entire coast of California a depth of fifteen hundred fathoms or more is reached as soon as we go westward to a distance of from twenty to seventy miles from the shores. The greater part of this sudden fall occurs in the last ten to fifty miles. At one hundred miles west of San Francisco the bottom is over twenty-five hundred fathoms deep. The bed of the ocean continues of a uniform depth greater than fifteen hundred fathoms until we reach the Sandwich Islands, the greatest depth being three thousand fathoms at a distance of about four hundred miles east of Honolulu, which great depth is maintained until we reach within ninety miles of Honolulu. At fifty miles from that town the depth is fifteen hundred fathoms. The calculations made by Professor Bache in 1854, based on the movements of the earthquake waves, gave an average depth of from twenty-two hundred to twenty-five hundred fathoms. The average depth of the present sounding is about twenty-four hundred fathoms. The bottom is generally a soft yellowish-brown ooze, and the temperature was every where 35° Fahrenheit. In all these soundings the steel wire recommended by Sir William Thomson has been used, and, wonderful to relate, the same wire has been used in the entire work, and the apparatus still works excellently. The soundings were made at an average distance of forty miles apart.

CARBONIC ACID IN ATMOSPHERIC AIR.

In a paper by Truchot upon the proportion of carbonic acid existing in atmospheric air, and its variation with altitude, it is stated, first, that the proportion is a little greater during the night than the day, amounting to about four volumes in the ten thousand by day, and four and three tenths by night, according to one determination, and to a little less by another; second, that the proportion of carbonic acid is not decidedly greater in the city than in the country, away from the direct influence of vegetation; third, that in the vicinity of plants with green leaves in continual vegetation the proportion of carbonic acid varies notably, whether the green portion is illumined by the sun, or is in the shade, or entirely in obscurity.

In reference to variation with altitude, it is found that the

proportion diminishes quite rapidly as we ascend in the atmosphere, a fact not at all remarkable when we reflect that it is at the surface of the earth that carbonic acid is produced, and that it is sensibly heavier than the air itself. The diffusion of the two gases, however, carries the carbonic acid to a considerable elevation, but this is not sufficient to saturate the air at a very great height.—6 *B*, 1873, 585.

THE LAWS OF STORMS IN NORTH AMERICA.

An important memoir on the laws of American storms was recently presented by Professor Loomis, of Yale College, to the National Academy of Science, and has lately been published in a revised edition. The conclusions arrived at by Professor Loomis were derived from an examination of the United States weather-maps, as issued from the Army Signal-office. Among the results attained by him, he states that the greatest daily velocity with which storm centres move along the earth's surface is found in February, the lowest in August. The average direction of the storm paths is more northerly in October than in July. Very rarely do storms travel in a west or northwest direction. Among the disturbing causes affecting the direction of the movement of a storm centre, he states that there must be a connection between it and the fall of rain (as has been established by numerous other investigators), and finds with reference to American storms, as an exact result, the following general law: that the average velocity of the storm progress is about thirty-nine miles per hour when the extent of rain area is 600 miles in advance of the storm, but its velocity is fourteen miles per hour when the rain area extends 350 miles in advance of the storm. The average course of the storm paths coincides very closely with the axis of the area over which rain falls during the preceding eight hours; the stronger the wind on the west side of a storm, the less is the velocity of the storm progress. At the height of 6000 feet, in the western quadrant of a storm, the velocity of the wind is more than double the rate of the storm's progress. The isobares inclosing the storm's centre in more than half the cases examined by him were elliptical, the major axes being half as long again as the minor axes. In a small number of storms the major axis was at least four times the minor. The longer axis most fre-

quently lies in a direction bearing about forty degrees east. —4 *D*, *July*, 1874.

ST. CLAIR DEVILLE'S WEATHER PROGNOSTICATIONS.

During the winter of 1873–4, the eminent French geologist Deville astonished the world by a number of weather predictions, whose fulfillment has been beyond all anticipation. M. Deville has very often published similar prognostications, which were always successful, but never perhaps in so striking a way. Having at hand an immense number of trustworthy observations, continued for many years in all Europe, and especially in France, he has discovered that there is monthly a large thermometrical oscillation, which he calls *dodecuple*, from the Greek word signifying twelve. This oscillation generally takes place in the second week of the month, but is not equally marked every month, and is not always a depression, but sometimes an elevation of temperature. The November oscillation, for instance, is a decided elevation of temperature. February, March, and May, on the contrary, have a cold period. The range of the oscillations, as well as their exact position in time, varies for different years, very probably because there is more than one single cause in operation to produce them. Happily, M. Deville has discovered an indication which enables him to foresee which oscillations are to be the largest or the smallest. He finds that each dodecuple oscillation of the temperature is preceded by a similar dodecuple oscillation in the barometric pressure, the difference of time between both oscillations being ordinarily five days. Consequently, having noticed a large barometric oscillation on March 2, he was certain that by the 8th of the month the regular thermometric oscillation for March should appear very decidedly. The deviation of the thermometric oscillation is uncertain to the extent of four or five days. Accordingly, on the 2d of March he predicted a very cold period to be approaching, beginning with the 9th and ending with the 13th of the month—a prediction that was fully verified, and was the more especially noticed because the cold was initiated by a heavy fall of snow, the first of the year, in that city. M. Deville is of opinion that the phenomenon observed by him is owing to the presence of certain cosmical streams of meteoric bod-

ies, which may chance to be distributed in an irregular manner in celestial space. These assumptions are purely hypothetical, but the existence of the dodecuple period in itself is based on observation, and can not be questioned.—12 *A*, 1874, IX., 445.

PHYSICAL GEOGRAPHY OF CHILE.

Mr. Reed, after a residence of four years in Chile, sends to the Bristol Naturalists' Society an interesting account of the physical geography and botany of that country, from which we take one or two items that may, perhaps, be novel. The volcanoes of the Chilian Andes are all to the south of Santiago. The altitude of the snow-line in the latitude of Santiago is estimated at 11,000 feet, but is frequently, according to the author, as high as from 13,000 to 15,000 feet. At a height of between 11,000 and 15,000 feet large patches of snow, possibly forming glaciers, have been noticed by him. The wind at mid-day on the mountain-tops is so strong that it is considered prudent to cross the mountains early in the morning. The height of the Andes affects the rain-fall, by depriving the east winds of a large amount of moisture. North of latitude 35° south the rain-fall at the coast is from 7 to 22 inches annually; but in latitudes 40° and 41° it amounts to from 105 to 115 inches. With regard to the desert of Atacama, Mr. Reed states that we have no reliable knowledge of its rain-fall, but, judging from the best information extant on the subject, it rains about twice in a century, according to one authority, or twice in a decade, according to another.—*Proc. Bristol Nat. Soc.*, I., I., 119.

REPORT OF THE COMMITTEE FOR THE EXPLORATION OF THE ADRIATIC.

The third annual report of the permanent committee for the investigation of the Adriatic Sea has just come to hand, from which it appears that this committee maintains eleven stations of observation at which meteorological and physical data are accumulated. In reference to the ocean itself, its temperature, its saltness, its tides, and its currents are carefully recorded, and all possible opportunities embraced for collecting journals of observation made upon vessels navigating that water. The commission stands in intimate con-

nection with the Austrian navy and commercial marine on the one hand, and with the system of schools and the National Meteorological Bureau on the other. The temperatures of the water are taken at various depths, increasing regularly from the surface down to 120 feet, and many interesting phenomena will be noted in examining the detailed observations as printed in the report.

The changes of temperature, at great depths, are certainly very remarkable; showing, apparently, that currents exist, even at the lowest depths just mentioned, which are directly dependent upon the winds and the temperature of the air at the surface. The numerous accurate observations of the tides, and the somewhat complicated phenomena that they present, have incited Professor Stahlberger to a more careful investigation of the ebb and flood tides in the harbor of Fiume, which he represents as probably being phenomena resulting from the interference of four simple oscillations of the ocean, arriving simultaneously at that harbor.—*Third Report Adr. Com.*

NEW ADMIRALTY WIND AND CURRENT CHARTS.

The Admiralty charts of the Pacific, Atlantic, and Indian oceans show, for the four seasons, the pressure, winds, and temperature over all parts of the globe covered by the sea. The most important piece of new work in these charts is the isobares, which give the barometric pressure for each of the seasons, and which, taken in connection with Buchan's isobares for the continents, may be regarded as the first approximation to a complete representation of the earth's atmosphere over both land and sea. A minute examination seems to show that the greatest care has been taken in the construction of these important means. In general, it seems that in the ocean to the westward of each of the continents there is at all seasons an area of high pressure. In these areas the absolute pressure is greatest during the winter months of the respective hemispheres. The position and shape of the isobares appear to be largely determined by that of the continents adjoining. The barometric gradients are much less on the western than on the eastern side of the areas of high pressure. Out of these areas the winds blow in all directions in accordance with the well-known Buys Ballot law, so call-

ed. The isothermal charts present many of the defects common to all similar charts published so far. The isothermals for the months of January and July are the only ones that have as yet been accurately worked out for the whole globe. These charts place it beyond all doubt that it is to the winds that we must now look as the prime mover of oceanic currents.—12 *A*, IX., 288.

MARITIME METEOROLOGY.

The Meteorological Congress at Vienna expressed its conviction that it was desirable that each country should, if possible, collect all its meteorological observations at one place; that the Institute for Maritime Meteorology should be established as near as possible to the sea, and that this institute might best be placed under the general management of the chief meteorological institute of the country. The convening of a Maritime Meteorological Conference was declared to be desirable, and a permanent committee appointed with this end in view.—12 *A*, X., 18.

METEOROLOGY IN YOKOHAMA.

The German branch at Yokohama of the Society for the Natural History and Ethnology of Eastern Asia shows in its last publication the activity of its members. Besides regular meteorological observations taken apparently under the auspices of the society, and published by them, we have very numerous determinations of altitudes in Japan, by means, of course, of the portable barometer, and have also some excellent descriptions of the volcano of Fusiyama. The first accurate measurement of the altitude of that volcano appears to be due to the members of this society; especially to Knipping, who seems to have made a series of observations for fourteen days, five times daily, at very carefully selected hours; simultaneous observations were made at three points, namely, the summit, the base, and intermediate stations. The best standard instruments by Green and other makers were used, and the computations were made by the formula lately published by Rühlmann, and which has met with so much acceptance. The resulting altitude of the summit of Fusiyama—12,235 feet—places it among the loftiest of volcanoes.—*Mittheilungen, Yokohama.*

PROPOSED CHART OF THE WEATHER.

Captain Hoffmeyer, director of the Royal Meteorological Institute of Copenhagen, announces his intention to publish daily charts of the weather from 60° east to 60° west longitude, and from 30° to 75° north latitude. The charts for the three months from December to February will be published as an experiment; and the work will be continued should suitable support be given. The cost will be four francs per month, exclusive of postal charges.—12 *A*, *June* 25, 1874, 146.

METEOROLOGY IN JAPAN.

At a recent meeting of the Asiatic Society of Japan it was stated that the Army Signal-office had expressed its willingness to assist the society, in any possible way, to secure a complete set of meteorological observations in Yokohama; that, on the other hand, the assistance of the Japanese government was much to be desired, in order that a general system of meteorological reports might be made throughout the empire, in accordance with the simultaneous system recommended at Vienna. The light-house and mining departments of Japan keep meteorological records, and it was remarked by Professor Ayrton that the Japanese government, so far as he was able to learn, was inclined to leave purely astronomical observations to the Naval Department, while the Engineering College would undertake those of a meteorological character. Men eminently adapted to the most accurate observations could, according to him, be readily found among the cultivated Japanese. The importance of telegraphic lines and telegraphic communication in Japan, in reference to earthquakes, was especially mentioned, and also the interest that would attach to electrical observations.—*Japan Weekly Mail*, 1874, 274.

DIFFERENCE OF TEMPERATURE BETWEEN THE COUNTRY AND CITY.

This difference has been investigated by Fines, who finds that, as has been also generally ascertained by other observations, the mean annual temperature in the interior of a city is decidedly higher than outside. On the other hand,

the maximum temperatures in the fall and winter are somewhat lower in the city, while in the spring and summer they are somewhat higher. On clear nights the difference between the minimum temperatures in the city and the country may amount to 13½° Fahr., that in the country being the lower of the two. Also, the annual average difference between the maxima and the minima is greater for the country than the city. —*Vierteljahres-Revue*, II., I., 139.

SELF-RECORDING BAROMETERS.

A memoir, by Wild, of St. Petersburg, on the means of keeping continuous records of barometric observations, has recently appeared, in which he shows that the electric self-recording barometer devised by him, and called the balance barometer, is compensated for temperature, and gives results whose accuracy is equal to that of the best direct observations with ordinary quicksilver barometers. Of all methods of recording the barometric pressure, Wild gives the preference to the electric, as compared with the photographic.—*Der Naturforscher*, p. 186.

TEMPERATURE AND PRESSURE DURING THE MONSOON MONTHS.

In an article on the climate of Asia in the region of the monsoons, Hann states:

1. That the annual mean diminution of temperature with altitude is, in the tropics, in general, perhaps not greater than in Central Europe.

2. During the regular monsoon, the diminution of temperature with altitude is slow on the windward side of the mountains, but rapid on the leeward side.

3. It can not be proved that the condensation of the enormous mass of aqueous vapor during the rainy season in the East Indies increases the temperature of the air in the higher stations, not even in those places where it might have been expected.

4. A phenomenon that is in intimate connection with the constant winds of the regions of the monsoons consists in the fact that a perceptible annual period exists, in the differences of atmospheric pressure, at stations of various altitudes. These differences have their greatest value when the wind blows from the lower to the higher stations, and their small-

est values in the opposite course.—*Sitz. Ber. Royal Acad. of Sciences, Vienna*, vol. lxvii., p. 448.

INFLUENCE OF THE SUN ON ATMOSPHERIC PRESSURE.

Hornstein, in a memoir on the dependence of the daily variation of the barometer upon the rotation of the sun on its axis, shows that the barometric pressure is so decidedly influenced by the aspect of the solar surface that the time of revolution of the sun on its axis (namely, twenty-five or twenty-six days) can be determined from barometric observations, as he has also been able to show with reference to magnetic observations. Concerning the explanation of the remarkable coincidences observed by him between meteorological and astronomical phenomena, he remarks that their explanation may, perhaps, be found in the influence on the earth of the electric condition of the solar surface.—*Sitz. Ber. Royal Acad. of Sciences, Vienna*, vol. lxvii., p. 416.

THE WINDS OF THE WEST INDIES.

The atmospheric currents that prevail at St. Thomas, in the West Indies, have been succinctly described by Palgrave as follows: The surface or lowest current blows approximately from the N.N.E., varying to the north during the night and early morning, and to the east from noon till sunset. This continues with great steadiness for nearly nine months of the year, its strength varying from a brisk gale between 3 and 4 A.M., and about the same hours P.M., to a light breeze at the intermediate hours. This current, known as the trade-wind, does not appear to exceed two thousand feet in vertical height. Next above this comes the southwest wind; this brings with it light cirrus clouds, while the northeast wind bears light masses of cumulus, with occasional short heavy showers. When the second or southwest current descends low enough to have effect on or near the surface, it is deflected to the south, and is accompanied by heavy rain-clouds and electrical phenomena. Above these two strata reigns the west wind, manifested by light cirrus clouds. These three winds blow with scarcely any interruption from November to June. Heavy gales, amounting to storms, sometimes blow here during the winter months from between N. and N.E. The white squalls are another peculiar class of

phenomena occurring in the winter and spring months. They take place on calm days, and their duration is very limited, and no instance is on record of any appearance of a circular motion of the clouds.—12 *A*, X., 65.

A SENSITIVE VARIATION BAROMETER.

Kohlrausch, in describing an ingenious barometer devised by him, very correctly remarks that such an instrument, which combines with unbounded sensitiveness the absence of any friction, which requires only a single observation to be made, which consumes no time, and possesses so slight a moment of inertia that it follows the variation of the atmospheric pressure in the fraction of a second, would probably excite some interest. The instrument devised by him consists of a metallic ring, such as belongs to a Bourdon aneroid, one side of which is firmly screwed to a holder. The other free end pushes against a small mirror in a metal frame, which is suspended on little springs of pendulum steel. A scale is placed about ten feet distant from the mirror, so that two inches of ordinary barometric change correspond to three feet on the scale. The influence of temperature upon the apparatus is extremely great, but, by introducing a proper amount of air within the tube, this may be reduced to a very small quantity. A curve is given showing the course of barometric pressure during three minutes of time on the occasion of a very stormy day, observations being noted down every three seconds. Kohlrausch states that he has never been able to detect any connection between barometric oscillations and flashes of lightning.—7 *A*, 1874, XLVII., 362.

BAROMETRIC VARIATIONS.

At the April meeting of the Meteorological Society, Professor J. K. Laughton gave some of his conclusions on the nature and cause of the diurnal variation of the barometer; and although these views seem to be identical with those maintained by Lamont, of Munich, as long ago as 1832, yet it is worth while to revive their consideration in these days when so much attention is directed to meteorological phenomena. Laughton believes that the cause of the diurnal variation is to be found, not in the different temperature and

humidity at different times of the day, but rather in the inertia of the atmosphere, which in the morning permits its elastic force to be increased by a rapidly increasing temperature before its inertia of rest can be overcome sufficiently to allow it to enlarge its volume; but when that inertia of rest is overcome, then the inertia of motion permits it to remove from the place of observation any excess of what is due to the increased elasticity. The nocturnal maximum and minimum are caused, then, by the resilient power of the air, which gives it alternately an inward and outward motion, and each way in excess of what is due to the decrease or increase of elasticity by reason of the inertia of motion. If this explanation is correct, we ought to find a certain tendency of the wind toward east in the morning and toward west in the evening; and this tendency does seem to be shown in the very few published observations which permit a comparison to be made. Further observations, as confirming or disproving the proposed theory, are much to be desired.—12 *A*, 1874, IX., 495.

PROTECTING INFLUENCE OF THE EARTH'S ATMOSPHERE.

Weilemann, after reducing the hourly observations made at Berne, Switzerland, for seven years, and deducing therefrom the laws of diurnal change of temperature, has investigated the influence of cloudiness on the daily variation, especially at night. He finds that the radiating power of the earth's surface is every where and at all times the same. The temperature in the morning is, he finds, in cloudy weather five or six degrees higher than in clear weather. And, again, the simple atmosphere of the earth surrounds it like a protecting layer of clouds, and that without this the earth would experience daily an enormous variation in temperature. Even the clear sky, or rather the moisture present as an invisible vapor, protects the earth, with an efficiency equal to about one third of that exerted by a layer of clouds, against too strong a daily change of temperature.—19 *C*, 1874, 194.

THE RECENT MAURITIUS HURRICANE.

Severe hurricanes have of late attracted so much attention that they have ceased to be novelties, and it would hardly be worth while to mention a special one that lately occurred

in the Indian Ocean, had it not happened that this one seems to have passed directly over the island of Mauritius, famous in meteorological science as the residence of Meldrum, and the place of operation of that meteorological society which has done so much to increase our knowledge of these terrible atmospheric disturbances. Indications of the late hurricane were observed on the 22d of March, at Port Louis, in a falling barometer and a rising wind, which increased until it reached its height on the 27th and 28th. Its greatest force was 11 on the Beaufort scale, and the barometer sank as low as 28.57 inches. The town itself presented a very sad appearance after the storm was over, the roofs and débris of fallen houses, and broken trees innumerable, partially obstructing all of the main streets. There were very few houses but were more or less injured; the museum of the Royal College was unroofed, many cellars were inundated and valuable goods destroyed, and many lives were lost.—12 *A*, *X.*, 15.

THE TEMPERATURE OF RAIN-WATER.

The temperature of falling rain in thunder-storms has been observed for four years by Breitenlohner. He finds that, during this interval, from one third to one fourth of the total rain-fall occurs in connection with thunder and lightning. The table showing his results explains many views on the various relations between the temperature of the air and the rain. The average of the observations shows that the falling rain belonging to storms that come from the northern portions of the horizon is generally colder, the differences diminishing as we turn to the west or east; while the rain-fall coming from the southwest is decidedly warmer. The greatest number of thunder-storms comes to his station in Austria from the northwest, and the next most numerous class of storms come from the southwest and the northeast. Comparing the quantity of rain-fall and the temperatures, it seems that the greatest rain-fall corresponds nearly to the colder temperatures, the least rain-fall to the warmer. The region of greatest number of storms is also the region of greatest rain-fall. Ordinarily the rain is more or less nearly the temperature of the air itself, and varies therefrom, at most, only a few tenths of a degree. From the study of the observa-

tions of Breitenlohner, it is evident that there is no such thing as the warm rain that is frequently spoken of—rains, that is to say, whose temperatures are materially different from that of the air. The correctness, however, of the observation that an increase of temperature does follow rainfall still remains, only, as is too frequently the case, the cause is confounded with the effect.—*Vierteljahres-Revue der Naturwissenschaften*, II., II., 90.

THE PHYSICAL THEORY OF UNDER-CURRENTS.

Dr. Carpenter, in illustration of the physical theory of under-currents, exhibited before the British Association a sectional map of the sea between Nova Scotia and the Bermudas, and including the isothermal lines. These lines were tilted up at the western end, indicating the existence of a cold current between the American coast and the Gulf Stream. This fact was interpreted by Dr. Carpenter as due to the rotation of the earth, combined with the fact that this cold water is flowing from north to south. A similar phenomenon is met with on the east coast of Japan, where there is a cold band between the Japan current and the land, and also in the North Sea, where there is glacial water within one hundred miles of the north coast of Scotland.

The existence of this cold current on the east coast of North America, extending down even off the coast of Massachusetts and beyond, is well known to American marine zoologists, the parties working in connection with the United States Fish Commission, in 1872 and 1873, having obtained at various localities, at depths of seventy-five to one hundred and twenty fathoms, temperatures as low as 35° Fahr.—15 *A*, *September* 5, 1874, 317.

MALLET'S THEORY OF VOLCANIC ENERGY.

The important memoir of Robert Mallet, which was announced nearly two years ago as presented to the Royal Society, the main points of which have already been published, has but recently been received in this country, and justifies the expectations concerning it, as being, evidently, one of the most valuable contributions to the science of seismology that has been made since the publication, in 1857, of the first principles of seismology by the same author.

Mallet accepts, in general, Sir William Thomson's view that plutonic action results from the dissipation of energy in the shape of terrestrial heat, and that the elevation, folding, and crushing of strata is the result of tangential pressure, originating in the contraction of the earth's crust by slow refrigeration. The heat is produced locally within the solid shell of our globe in three principal ways: first, by the compression of rocks within the limits of elasticity; second, the friction by the sliding of beds of rock upon each other; third, the crushing of rock. He attempts to prove these points by showing that the gravitation of the unsupported shell of the earth is adequate to crush into powder all the materials of which it consists, and that the heat produced by crushing is sufficient to account for existing phenomena. A long series of highly accurate experiments and observations upon the crushing of cubes of different rocks gives him the numerical data for computing the exact increase of temperature due to the contraction of the earth. From the observations on the contraction due to cooling, he concludes that the earth's diameter, when liquid, must have been greater by one hundred and eighty-nine miles than at present.—4 *D*, VII., 142.

THE CLIMATE OF CARINTHIA.

Prettner has published an important and in many respects a masterly work on the climate of Carinthia. The number of stations he uses amounts to forty-two, being an average of one to every four square miles of the territory. Many of these stations offer him a series of observations that extend over long periods of years. — *Vierteljahres-Revue*, II., I., 137.

MATHEMATICAL THEORY OF THE WINDS.

An excellent mathematical paper, by Professor Wm. Ferrel, of the Coast Survey, has recently been presented to the National Academy of Science, in reference to the laws of cyclones. The mechanical theory of the cause of these atmospheric disturbances was made known by Ferrel some twenty years ago. In the present paper he is able to refer directly to the great mass of observations that have accumulated since the establishment of national weather bureaus throughout the world, and shows that the average of great numbers of observations completely verifies the mathematical deductions

originally published by him.—*Proc. Nat. Acad. of Sci.*, *New York Daily Tribune*, *April* 25, 1874.

MOVEMENTS OF HAIL-STORMS IN EUROPE.

An investigation of the occurrence of hail-storms is contained in Karsten's monograph on the climate of Schleswig-Holstein. In this investigation he has made use of the data collected by the Hail Insurance Company of Kiel, and has been able to present a reliable hail-chart for this region. It appears from this chart that the hail-storms move from the Elbe northeastward to the Baltic; and in Holstein they preserve the same direction, but without passing beyond the Eider. This average direction of hail-storms in Schleswig-Holstein agrees very nearly with that deduced by Le Verrier for the territory of France.—*Vierteljahres-Revue*, II., I., 137.

SERIES OF EXPERIMENTAL THERMOMETERS.

Mr. G. J. Symons exhibited to the British Association a series of fourteen carefully constructed thermometers, differing either in the size or shape of the bulbs or in the material with which they were filled, some being mercurial and others containing alcohol. As the result of experiments made with them, it is ascertained that very large mercurial bulbs are but little better than those of the same size filled with alcohol, but that with small bulbs the mercury is much more sensitive.—5 *A*, *October*, 1874, 444.

THE INCLINATION OF THE WIND TO THE EARTH'S SURFACE.

Montigny, by means of observations made on the tower at Antwerp, has shown that every wind must have a definite inclination to the level surface of the sea. The influence of the winds upon the surface of the water in oceans and lakes would be an impossibility if the wind moved in a direction parallel to that surface. The cause of this inclination of the wind is easy to be found, and lies in the resistance or friction which the lowest layers of air experience in moving over the uneven surface of the earth. Montigny develops this relation in some detail, and calls the attention of meteorologists to the fact that this matter must be attended to by them in their observations of the wind. He suggests three different ways of indicating and measuring the inclination of the wind.—19 *C*, 1874, 195.

C. GENERAL PHYSICS.

THE RESISTANCE OF GLASS TUBES TO RUPTURE.

M. Cailletet finds that a tube stands pressure from the outside better than the inside; but the pressures that a tube can bear from the inside are very great. A glass tube of nine millimeters internal diameter and one millimeter thick was submitted to an outside pressure of 460 atmospheres, without injury, and subsequently to an internal pressure of 104 atmospheres, when it burst.—12 *A*, IX., 316.

THE RELATIONSHIP BETWEEN ELECTRICITY, HEAT, AND MOLECULAR FORCES.

Professor Barrett, of Dublin, calls attention to certain remarkable molecular changes occurring in iron wire at a low red heat. Mr. Gore, in 1869, published the important fact that, when iron wire is heated to bright incandescence, and then allowed to cool, a momentary elongation occurs just after it has begun to contract by cooling. Mr. Barrett having undertaken further to investigate this subject, finds that during the preliminary heating of the wire a slight and momentary retrogression in the otherwise regular expansion was noticed at a temperature corresponding to the powerful jerk that occurred on cooling; and, again, it was evident that the anomalous deportment of the iron occurred approximately at the same temperature at which iron undergoes magnetic change. All kinds of iron do not exhibit this behavior, some showing it in a more or less marked degree. Barrett was not able to detect any change in heating or cooling in certain specimens of good, soft iron wire, but in hard iron wire, and notably in steel wire, it is very apparent.—*Lon., Ed., and Dub. Philos. Mag.*, 1873, 472.

THE FIRST REPORT OF THE BRITISH ASSOCIATION COMMITTEE ON DYNAMICAL AND ELECTRICAL UNITS.

The first report of this committee was made at the recent meeting of the British Association for the Advancement of Science, and is confined principally to the selection and no-

menclature of units of force and energy, under which head the committee is itself prepared to offer certain definite recommendations, which are as follows: First, the gramme, centimeter, and second are recommended as the units of mass, length, and time, respectively; a combination which has the advantage of making the unit of mass appear identical with the mass of the unit volume of water—in other words, of making the value of the density of water appear equal to unity. From these fundamental units the units of electrical and magnetic magnitudes, now in common use, may be derived; and it is recommended that, until special names shall be prepared for them, they be distinguished from absolute units, otherwise derived, by the three initial letters C. G. S. As regards the name to be given to the C. G. S. unit of force, it is recommended that it be a derivative of the Greek word δυναμις—the form *dynamy* appears to be the most satisfactory to etomologists. The work done by this force working through a centimeter is the C. G. S. unit of work, for which is proposed a name derived from the Greek, *erg;* the C. G. S. unit of power is the power of doing work at the rate of one *erg* per second, and the power of an engine can be specified in *ergs* per second. The common and extremely variable unit of one horse-power is about three fourths of an erg-ten second. For the expression of high decimal multiples and sub-multiples, the system introduced by Mr. Stoney is recommended. It consists in denoting the exponent of the power of ten, which serves as a multiplier by an appended cardinal number, if the exponent be positive, and by a prefixed ordinal number when the exponent is negative; thus ten to the ninth power, or one thousand million grammes, constitutes a "gramme-nine," and the one thousand millionth of a gramme constitutes a "ninth-gramme."—*Proc. British Association.*

NEW INSTRUMENTS EXHIBITED AT THE APRIL SOIRÉE OF THE ROYAL SOCIETY.

At a recent *soirée* of the Royal Society (being the first held in its new apartments) there was a remarkably good display of scientific apparatus, including the following pieces in the department of physics, some of which may possibly be new to American readers. Mr. Crookes exhibited his experiments showing the attraction and repulsion accompanying

radiation. Messrs. Whitehouse & Latimer Clark, an electrical recorder for registering time, speed, distance, and number of passengers inside and out of tram-cars and omnibuses. This information is registered in four parallel columns, by automatic pens, in red ink, on long strips of paper. Dr. Tyndall exhibited the apparatus constructed by himself and his assistant, Mr. Cottrell, for showing the stoppage of sound by a non-homogeneous mixture of air and vapors, and also experiments illustrating Savart's observations on the action of sound on a jet of water. Mr. J. Norman Lockyer exhibited a series of photographs of metallic and solar spectra, enlarged from photographs taken by his new method of comparing spectra by means of a perforated shutter sliding in front of the slit of the spectroscope. Captain J. E. Davis exhibited a sextant which will be found particularly useful in night observations, as it permits the taking of a series of observations without reading off any until the close of the series, this being accomplished by the adaptation of a micrometer movement to the tangent screw, and the application of indicators to the arc of the instrument. Messrs. Tisley & Spiller exhibited their compound pendulum apparatus in action, and distributed cards with the exquisite curves described upon them. Mr. E. B. Tylor's ingenious apparatus for illustrating refraction was shown, and Mr. Spottiswoode's triple combination double-image prism. Messrs. Negretti & Zambra exhibited their new ingenious upsetting thermometer, for recording temperatures. Mr. G. P. Bidder's micrometer is described as a most ingenious device for observing the transit of very faint stars. The spider lines are illuminated by a side light, and are reflected into the eye-piece by a mirror, as bright lines upon a dark ground, and can be colored at pleasure by the interposition of colored glasses. The beautiful photometer of Sir Charles Wheatstone is worthy of special attention. The screen slides along the divided scale, and its motion causes the increased overlapping of two sliding wedges of neutral-tint glass. The light is looked at directly through a hole in the screen, and the latter moved along on the scale until the light just ceases to be visible. Dr. Norris, of Birmingham, exhibited experiments showing that the statement that India rubber contracts by heat is incorrect. This substance, it is true, contracts in the direction of its length,

but it expands in breadth at the same time, thus resembling the so-called contraction of muscular fibre.—12 *A*, IX., 502.

PLATEAU'S RESEARCHES ON THE PHENOMENA OF LIQUID FILMS.

The great investigations of Professor Plateau, of Ghent, both experimental and theoretical, on the statics of liquids which are exposed only to molecular forces, and are freed from the influence of gravity, have been recently published in two volumes, with much new material. These investigations have occupied Plateau's attention for over thirty years past, and many of his results have become familiar to American readers through the admirable translations published from year to year in the annual reports of the Secretary of the Smithsonian Institution. In the volumes before us, Plateau begins with some preliminary and general notions, and proceeds to the verification of the more important principles of the theory of capillary action. In the second chapter he investigates the questions relative to figures of equilibrium in general; the simpler surfaces of revolution are passed over somewhat cursorily, although with sufficient fullness; and especial attention is paid to the new figures of revolution, which he denominates the unduloid, catenoid, and nodiod, which he has himself been so fortunate as to discover and very successfully investigate. The research upon the superior limit of the very small distance of sensible molecular attraction leads him to the result that in the glyceric liquid which he employs the radius of sensible attraction is less than the 0.0017 part of a millimeter. The subject of the tension of the surface of a liquid film is one of the most important matters in the investigations of Plateau, and has received from him, as it has indeed from very many investigators, the full attention that it deserves. The theoretical investigations of Thomson, as well as the experimental studies of Quincke, Dupré, Van der Mensbrugghe, and many other observers, come in to supplement his own exhaustive researches. The curious question of the relations between the superficial viscoscity of a liquid and the interior viscoscity is investigated, for pure water, for glycerine, for alcohol, for sulphuric ether, and for several other typical chemical substances. Among the causes influencing the duration of thin liquid films, Plateau enumerates:

The small agitations of air.

The evaporation of the liquid.

The temperature.

The action of gravity.

The combination of the films into more complicated systems.

The size of the films: the smaller films last longer than the large ones.

The nature of the solid to which the film adheres.

The historical portion of the second volume is not the least interesting part of the book. Beginning with the knowledge which has come down to us from the ancients, and giving a full summary of the remarks of Boyle, Hooke, Newton, Gray, and Leidenfrost, he takes up, in succession, the works of all those who have followed these early explorers in this field, giving what appears to be an absolutely exhaustive review of all published knowledge on this subject. After considering, in an experimental way, the question of the stability of the figures of equilibrium, and showing that the experiments afford a complete verification of theoretical notions in this respect, Plateau concludes his work with the application of the properties that he has discovered to the theory of the formation of drops, the explosion of bubbles, and the constitution of liquid veins flowing from circular orifices. The historical treatment of the matter in connection with the last-named subject is equally as full as the previously given narration of the literature on the subject of thin films. Plateau concludes with a list of the works of all authors accessible to him published previous to December, 1873. It has become the custom of late years for well-known scientists to collect together, in convenient form for reference, the essays contributed by them to various scientific bodies throughout the world, a custom that certainly has very much to commend it; but Plateau has departed from custom in one point—namely, that, instead of giving us the separate essays as they were originally published, he has revised the entire series, and has in the present work followed a more methodical order, and rectified numerous passages, filling up many gaps, especially in historical matters. He has even added two entirely new investigations relative to the superficial viscosity of liquids and the constitution of liquid veins.—*Statique des Liquides, Bruxelles*, 1874.

THE MOLECULES OF ETHER.

In connection with the very interesting lecture of Maxwell on molecules, it is worth while to record the confirmation of his results, recently attained by Herwig. This author, starting from the comparison of the expression for the thermal effect of a galvanic current, with the expression for the *vis viva* represented therein, at any moment, by the motion of the electric particles, and holding fast to the notion of only one electric fluid, obtains, by a series of reasonably approximate assumptions, the conclusion that the weight of a molecule of ether amounts to considerably more than the one-hundredth power of one tenth of a milligramme.—7 *A*, XLVII., 191.

TERQUEM'S TONOMETER.

In order to determine the absolute number of vibrations of any body, Terquem has transformed the vibrascope of Lissajous into a tonometer. He had made four diapasons, furnished with cursors, each carrying at the extremity of one of its branches, like the diapason of the vibrascope, a small biconvex lens to serve as an objective. The standard diapason was then so fixed that the vibration of any tube or string to be examined could be seen through the convex lens. When the standard and experimental tube vibrated together, and when they vibrated in opposite directions, a phenomenon was perceived similar to that of the beats heard when two sounds interfere with each other. By the observation of these beats, it was a very simple matter to decide how frequently the experimental body was vibrating, and thus to determine the tone that issued from it.

MATHEMATICAL LAWS OF ELASTICITY.

Professor Curioni, of the engineering school at Turin, has published a memoir upon the law of the molecular resistances in any elastic solid whatever, elicited by any system of forces, and has applied his mathematical deductions to the case of beams compressed, distended, bent, and twisted in various ways. This problem, which has been treated by so many eminent mathematicians since the days of Euler, and which still, in all its generality, eludes the power of the best math-

ematicians, seems to be treated by the author with clearness, in that he expresses the law of the molecular resistance by the summation of two integrals, each depending upon the figure of the body and the nature of their applied forces. In the application to special cases of the very general formula which he deduces in the first portion of his essay, its convenience at once becomes apparent by the readiness with which it reduces to very simple equations. Thus, by its means, the problem to find the curve of a beam acted on by its own weight, and by forces that bend it into a complete semicircle, is resolved in less than a page of text, and by one simple substitution; and the author points out how the general formula given by him can be applied to any engineering problem in the consideration of the strength of materials.—*Atti della R. Ac. D. Scienze, Turin*, 1873, VIII., p. 33.

A NEW METHOD FOR THE DETERMINATION OF ELASTICITY.

Among the inaugural dissertations of the competitors for the Degree of Philosophy at the University of Jena, we notice one by Hulsse, detailing a new method of determining the co-efficient of elasticity. The author states that this method was suggested to him in connection with his labors at Dresden, in 1871, as an assistant to the Royal Commission on standards of Weights and Measures. In connection with the use of very accurate balances, he remarks that the relation between a loaded and an unloaded balance ought to give the means of determining the co-efficient of elasticity of the balance-beam, an idea that seems to have been previously suggested by Hartig in 1859; and the author's plan consists in determining the deflection of the end of the beam from the observed duration of the vibrations under different loads, and also in determining, independently, by theoretical formulæ, the same time of vibration under the assumption that no deflection takes place. By the comparison of the two results he arrives at the co-efficient of elasticity. The difficulties experienced by former investigators have consisted mainly in the fact that they have attempted to measure directly the deflection of a beam, although the quantity itself is extremely small. The author applies his method of vibrations to beams made of three different kinds of wood, and deduces the co-efficients of elasticity from a number of series of experiments

with each bar, the results of which agree with each other far within the limiting probable errors.—*Hulsse's Inaugural Dissertation*, 1873.

PECULIARITIES OF ORGAN-PIPES.

Hermann Smith, the well-known constructor of organs, writing on the variability of the node in organ-pipes, states that this is as yet an unrecognized phase in acoustics. From the time of Savart it has been known that the nodal division of the open organ-pipe does not take place at the exact half of the length, and that the half nearest the embouchure is the shortest of these divisions. The position of the node is, perhaps, the most significant fact that presents itself to the attention of the investigator, whether student or teacher. The actual extent of the disparity between the "unequal halves" of the pipe can be ascertained, and is found to be subject to laws as definite as are found in other dynamical problems. If a standard open diapason pipe be made for some designed pitch, whatever that pitch may be, it may safely be predicted that the pipe will stand considerably short of the full theoretical length. It ought to be about one eighth less, while for the vox-angelica pipes the length of the pipe is about one twelfth less than that which theory demands. Unless this peculiarity of organ-pipes is properly understood and allowed for, great errors arise in all determinations of the velocity of sound in various gases. Hermann Smith's conclusion is that in an organ-pipe there are three different velocities speeding at different rates and concurring in every vibration, and essential to the synchronic time of its note.—12 *A*, IX., 302.

REFRACTION OF SOUND BY THE ATMOSPHERE.

Professor Reynolds, of Manchester, has communicated to the Royal Society a paper looking to the explanation of many of the so-called abnormal phenomena of sound, and particularly the results of Professor Tyndall's recent observations on the audibility of fog-signals. Professor Reynolds states that the effect of wind on sound is due to the lifting of the sound from the ground, and not to its destruction, as is generally supposed; the lifting of the sound being the result of a refraction due to the different velocities with which the air moves at the ground, and at a small elevation above it. Experi-

ments establishing this explanation were made over a nearly flat meadow when covered with snow, and again when covered with grass. He finds that the velocity of wind over grass differs by one half at elevations of one to eight feet, and by somewhat less over snow; that the same sound is heard at more than double the distance over snow at which it can be heard over grass; that sounds proceeding with the wind are brought down to the ground, so that the range of sound over rough ground is greater with the wind than at right angles to it; that sounds proceeding against the wind are lifted off the ground, and hence the range is diminished. A second class of phenomena, namely, the fact which has been often observed, that distant sounds can be heard much better during the night than during the day, and on cloudy days better than on clear days, Professor Reynolds explains as the result, not of the heterogeneous condition of the air, as maintained by Professor Tyndall, but of the refraction of the sound. Since the velocity of sound through air increases with the temperature, every degree from 32 to 70 adding one foot per second to the velocity, therefore an upward diminution in the temperature of the air must produce a similar effect to that of wind lifting the sound. He shows that with a clear sky, and a diminution of temperature, such as results from Mr. Glaisher's observations, the rays of sound, otherwise horizontal, would be bent upward on arcs of circles, the radii of which are about twenty miles, while with a cloudy sky the radii are forty miles; so that the upward refraction is twice as great on bright hot days as it is when the sky is cloudy, and, of course, still more under exceptional circumstances. This theoretical result is then applied to one of Professor Tyndall's observations made on the 3d of July, on which occasion he observed that the guns fired on the cliffs of South Foreland, 235 feet high, were inaudible at a distance of two miles. Professor Reynolds shows that, in this case, the sound-wave would be refracted, so as to pass completely over the head of the observer standing on a ship's deck twenty feet high; but that, had Professor Tyndall been able to go thirty feet up the mast, he might have heard the sound distinctly. Instruments placed at the bottom of the cliff would, for the same reason, have a still shorter range of audibility; and it is singular that, throughout his report, Profess-

or Tyndall makes no comment on their performance, possibly because they were found at once to be inferior. There are many other phenomena connected with sound of which this refraction affords an explanation: such as the very great distances at which the sound of battles has been heard, as well as the distinctness of distant thunder. In general, distant sounds originating near the ground are not heard with any thing like their full power by an observer at the same elevation, while, for every step of ascent above the earth, he perceives a corresponding increase in its distinctness.—12 *A*, 1873, IX., 513.

AN OBSERVATION IN ACOUSTICS BY GALILEO.

Professor Sedley Taylor calls attention to a recent unexpected discovery in the writings of Galileo, showing that this philosopher was acquainted with the principles of acoustics concerned in the phenomenon of resonance; and, again, that he devised the earliest known direct experimental determination of the ratio of the vibrations for a known musical interval. Galileo relates that he was one day engaged in scraping a brass plate with an iron chisel, in order to remove some spots from it, and noticed that the passage of the chisel across the plate was sometimes accompanied by a shrill whistling sound. On looking closely at the plate, he found that the chisel had left on its surface a long row of indentations, parallel to each other, and separated by exactly equal intervals. This occurred only when the sound was heard. It was found that a rapid passage of the chisel gave rise to a more acute sound, and the resulting indentations were closer together. After a number of trials, two sets of markings were obtained, which corresponded to a pair of notes, making an exact fifth with each other; and, on counting the number of indentations contained in a given length of each series, it appeared that, for thirty of the lower sounds, there were forty-five of the higher; whence Galileo inferred that what really determined a musical interval was the ratio of the numbers of vibrations performed in equal times by its constituent notes.—12 *A*, 1873, IX., 169.

THE ELECTRIC DIAPASON.

A series of highly important experiments, which, though to a great extent technical, promise eventually to lead to im-

portant results, both in our knowledge of the laws of elasticity and in their application to acoustics, has been made by Mercadier, on the movement of an elastic thread, of which one extremity is animated by a vibratory movement. M. Mercadier had been led to this study in the construction of an electric diapason, to which he had attached a metallic thread, in order to reduce its vibrations. The diapason is, independently of the thread, considered here only as a sounding body of special form, animated by a known vibratory movement. His researches affirm, in great part, the laws indicated by M. Gripon, and have also furnished still newer results. Mercadier distinguishes two cases that occur; first, that in which the vibrating thread follows at its extremity vibrations exactly parallel to those of the diapason. This he calls its normal state. In the other case, the extremity of the thread vibrates in a more complicated manner, and, sometimes, even *in twisting* vibrations. These complicated effects take place especially when the end is very fine; but in all cases this state of vibration, which he calls the abnormal state, is characterized by a diminution of the amplitude and intensity of the movement of the diapason itself, a remarkable diminution, which can even proceed so far as to completely extinguish those vibrations. He is able always to control the passage from a normal to an abnormal state of vibration. Among the numerous laws that he has published concerning these states of vibration, we may cite the following:

In the normal state the thread presents a series of nodes and vibrating segments, whose relations to each other, as regards length and position, he has determined for a number of metals, especially for iron, copper, platinum, and aluminum. Whatever may be its length, if the thread vibrate regularly or normally, it also vibrates synchronously with the diapason. These vibrations are recorded very clearly upon a revolving cylinder, and can be easily counted. For different diapasons and the same thread, the normal distances of the nodes are in the inverse ratio of the square roots of the number of vibrations of the diapason. If we make the amplitude of the diapason to vary, the form of the vibration of the thread does not change, except with regard to the positions of the three or four first nodes, counting from the point of attachment to the diapason; the nodes removing from it or ap-

proaching it, according as the amplitude is increased or diminished. This displacement diminishes very rapidly for each successive node that is displaced, from the first to the last. Different threads having the same section have their normal nodal distances, proportional to the fourth roots of the quotients of the co-efficients of elasticity divided by density. If, now, a thread that is vibrating in its normal state be shortened by a millimeter, for example, we observe the following fact: First, the thread continues to vibrate regularly, the amplitude of its free extremity varies, but that of the diapason remains constant. Cutting off a certain other portion, the rectilinear vibrations of the thread commence to change, becoming curvilinear, their amplitude increases, and that of the diapason begins to diminish. Continuing to shorten the thread, the form of the vibrations of the thread becomes still more pronounced. Finally, we arrive at such a length that the amplitude of the diapason diminishes to nothing. It is at this time impossible to make the diapason vibrate. Continuing to shorten the thread, the same phenomena are reproduced in an inverse order, the vibrations of the thread become plane, and the amplitude of the diapason returns to its normal value. These phenomena have been observed by Mercadier on threads whose initial length was fifty or sixty centimeters, and which have been shortened, millimeter by millimeter, measuring each time the amplitude of the extremity of the thread and that of the diapason; and he finds that the lengths of the threads for which the amplitudes of the free end are a minimum and equal to that of the diapason, are, beginning with the shortest, in an arithmetic progression, of which the ratio is precisely the normal nodal distances of the thread. And, again, the lengths of the threads corresponding to the points of complete extinction of the diapason are also, beginning with the shortest, in an arithmetic progression, whose ratio is the normal nodal distance. And, again, each of the points corresponding to the minimum amplitude of the thread is very nearly at an equal distance from the two points of extinction of the diapason between which it is comprised. The existence of these points of extinction of the diapason constitutes a remarkable fact. In generalizing from it, one is led to conclude that any body, affected by a vibratory movement of a given pe-

riod, can have its vibrations completely extinguished by attaching to it an elastic thread of a proper length and susceptible of transverse vibrations, in a plane parallel to that of the vibrations of the body.—6 *B*, 1873, 671.

THE ELLIPTIC POLARIZATION OF LIGHT.

Wiedemann has investigated the elliptic polarization of light, and its relations to the superficial colors of bodies. His observations show that the semi-metallic bodies behave, in reference to the rate of retardation in their transparent parts, similarly to the transparent bodies themselves; but in their opaque parts they behave similarly to the metals. Again, the more that light of a given wave-length is absorbed by any body, by so much the greater is also the ellipticity of the vibrations when reflected from the body. And, again, the colors that are best reflected show, in general, the strongest elliptic polarization. The principal angle of incidence is subjected to the greatest variations for light whose wavelengths correspond nearly to the absorption bands.—*Inaugural Dissertation*, *Berlin*, 1873.

PLATEAU'S GLYCERIC LIQUID.

Professor Brush refers to the following mixture, as being easier to prepare than the so-called Plateau's glyceric liquid, as well adapted to the production of the beautiful soapbubbles, and other thin films, whose remarkable properties Professor Plateau has so successfully studied during the past twenty years. One gramme of dry Marseilles soap is dissolved in one hundred grammes of warm water. This is filtered, and to every hundred cubic centimeters of the solution forty grammes of white sugar are added. Bubbles made with this liquid will last several hours. For illustrating the colors of thin films, a copper ring fifteen centimeters in diameter, of wire the fifth of an inch thick, is used, which is mounted vertically on a stand, and can be covered with a bell-glass. A portion of the liquid being poured into a plate, the ring is laid flat on its surface, and on removal a film of the liquid will adhere to it. Covering the ring with gutta-percha varnish facilitates this adherence. The ring is then mounted vertically on its stand, and on viewing it at an angle of 45° beautiful bands of color are observed successively changing,

until, in half or three quarters of an hour, it gives a uniform yellow of the first order. The colors are as brilliant as those given by selenite films in polarized light.—4 *D*, 1874, VII., 415.

POLARIZATION BY DIFFUSION.

Soret, commenting upon the theory of Hirn, adduces a number of experiments made by himself in the same line of research. He states that he has repeated the famous experiment of Professor Tyndall on the polarization of light reflected from a gas, or liquid, holding hydrogeneous particles in suspension. He has employed lamp-black as the diffuser, and detected the polarization of the light immediately that a beam of sunlight was made to fall on a smoky flame of illuminating gas, as well as when it fell upon the smoky or non-incandescent lamp-black above the flame. With a Bengal burner and glass chimney, the flame ceased to be smoky, and the luminous pencil was no longer perceived.—7 *A*, XLVII., 205.

THE POLARIZATION OF FLAMES.

Hirn, who is known by his investigations in the department of heat as well as in reference to the rings of Saturn, has also lately occupied himself with the optical properties of flames; and, for the explanation of the whole of the phenomena, he suggests the hypothesis that the solid incandescent particles to which the flame owes its brightness become transparent at that high temperature, and have no longer any sensible reflecting power. As is well known, one of Arago's first observations in optics demonstrated that, in general, the light from flames presents no trace of polarization; and it was this observation that served to establish a most important landmark in the theory of the sun, by informing us that the solar light emanates from a gas, and not from a solid or liquid. This fact, discovered by Arago, is not inconsistent with other known phenomena when the flame is that of a burning gas, but when it is formed of a mixture of a burning gas with the dust of a solid body—in which case not only does each solid particle emit light of its own, but must reflect light from other sources, since it is illumined by other particles—then how is the total absence of polarization to be accounted for? According to Hirn, it is not difficult to explain this in the case

of carbureted gases. In these the flame is found to contain carbon in the form of lamp-black. The particles of carbon become incandescent so long as they remain in the flame. But lamp-black reflects very little light, or none at all; therefore the absence of light polarized by reflection seems very natural in the flames of carbureted gases. This, however, is but a partial explanation, as he himself subsequently shows. He states that he has examined with the polariscope the flame of phosphorus, burning both in the shade and in the bright sunshine, and has not been able to perceive the least appearance of polarization. So also in the case of the flame issuing from the top of the cupola of a coke furnace; neither at night nor in bright sunshine was he able to detect the slightest trace of polarization. Yet when, at the end of the operation, the furnace door was opened, and a thick bluish smoke escaped, instead of flame, at the top, this smoke, strongly illumined by the still glowing interior, gave decided evidences of a polarized light.—7 *A*, XLVII., 206.

GALVANIC POLARIZATION IN LIQUIDS FREE FROM GAS.

Professor Helmholtz has for a long time been investigating the question as to the cause of the apparently unlimited duration of the polarizing current which, although feeble, arises when a Daniell's zinc-copper element is closed by a water-decomposition cell with platinum electrodes. He shows that the battery can maintain an unceasing feeble current between the platinum electrodes, not merely when the liquid is in contact with air, but also when in contact with a perfectly closed vessel, if its electrodes are saturated with oxygen, and its liquid holds oxygen in solution. A simple test apparatus being devised, he states that he has seen a current maintained for weeks together by electrolytic convection alone, under the influence of a limited stock of oxygen in a hermetically isolated liquid; and hydrogen is much more efficient than oxygen. When the plates and the liquid are copiously saturated with electrolytically developed hydrogen, the decomposition cell behaves toward feebler currents, for hours, or even for days, as a non-polarizable element similar to a solution of silver between silver electrodes. The constancy of the current, however, comes to an end when, through convection of the hydrogen, its store in one of the plates begins

to run short. He succeeds in producing this state of hydrogen saturation better by employing diluted sulphuric acid as the electrolytical liquid than with distilled water.—7 *A*, XLVII., 145.

DIFFRACTION GRATINGS.

The fine-ruled gratings that give such perfect spectra of the light falling upon them have of late years become very important in all experiments relating to spectrum analysis. Indeed, they promise to supplant entirely the ordinary glass prism in certain classes of work, especially in that relating to the heat spectra. A memoir by Lord Rayleigh gives some interesting accounts of the methods of manufacturing these gratings, and a more elaborate investigation of the theory of their action than is to be found elsewhere. The original gratings, as made by Nobert, of Paris, and Rutherford, of New York, are evidently produced by very delicate and exact automatic ruling-machines, by means of which a glass or metallic plate may be ruled by a fine diamond point with lines so closely crowded that at least 6000 grooves are contained in one inch; and the regularity of the rulings is such, as shown by the purity of the spectra, that a systematic irregularity in the width of the grooves to the extent of the one-thousandth part of their own intervals, or the six-millionth part of an inch, does not exist. Having obtained specimens of the original gratings, Lord Rayleigh desired to devise some method of reproducing them, and attempted first of all to do so by photography. Having endeavored to photograph coarse gratings upon glass, so as to obtain, in their diminished pictures, fine-ruled gratings, and having found that the inherent imperfections of the optical appliances, if not the laws of light themselves, interpose an almost insuperable obstacle to obtaining adequate results, the author then resorted to the method of contact printing, in which the photographic film is brought, by moderate pressure in a printing-frame, within a very short distance of the lines of the original grating. If, then, the source of light be moderately small, and the rays fall perpendicularly, the copy rarely fails in definition, unless there is some photographic defect. In this way he has copied gratings of 3000 and 6000 lines to the linear inch; he finds that, on actual trial, the spectra given by the

coarser gratings are much the best in respect of definition, and that the same difference is observed in the copies. He has also attempted to take copies of copies, but with indifferent success, even when the performance of the first copy was not perceptibly inferior to that of the original. Gratings may be copied without the aid of photography, by simply taking a cast. He has obtained a fair result by allowing filtered gelatine to dry, after being poured on the 3000-line Nobert grating. This method, however, is attended with much more risk to the original. In considering the theory of the action of these gratings on a beam of light, Lord Rayleigh shows that, in order that the grating may be able to resolve the D line of the solar spectrum, there must be no systematic irregularity to the extent of a thousandth part of the interval between the successive lines, though single lines may, of course, be out of position to a much larger amount.—7 *A*, XLVII., 81–193.

THE LAWS OF THE REFLECTION OF LIGHT.

The question of the laws of reflection of light, as far as regards the intensity of the reflected light, has been the subject of investigation, both theoretical and experimental, by Professor Pickering, of Boston. The quantity of light reflected increases with the co-efficient of refraction, a law which explains many familiar phenomena—such as the brilliancy of the diamond, which is practically understood in the diamond mines, where it is customary to distinguish the rough gem from the quartz pebbles by immersing them in water, when the pebbles become scarcely distinguishable from each other and from the water, while the diamond becomes prominently visible. In order to compare the theoretical formulæ of Fresnel with the facts of nature, Professor Pickering devised a modification of the Savart polarimeter, and has applied his instrument, first of all, to the study of the polarization of the light of the sky. All his observations point to one very remarkable result: namely, that the polarization is the same for a given solar distance for any meridian distance; or, in other words, is the same for all points equally distant from the sun. The variations from this law are slight, and may be ascribed partly to errors of observations, and partly to real irregularities in the atmosphere. The simplest explana-

tion of the polarization of the sky is to assume that it is the result of specular reflection from molecules of air or aqueous vapor. According to this, the polarization should be complete at a distance of ninety degrees from the sun, while in reality it is only about seventy per cent. The explanation of this and other deviations is possibly found in the reflection of the sun from the sea lying to the east of Boston. When the polarimeter is directed toward a polished colored plane surface, the two images assume different tints, one having the color of the reflecting body itself, the other having the color of the original light. On examining the light of the sky under proper circumstances, Professor Pickering concludes, from a consideration of this principle, that the true color of the sky particles is blue.—*Pickering, Applications of Fresnel's Formula.*

THE DIFFUSION OF GASES.

In a recent number of the *Archives of Physical Sciences*, Dufour gives a detailed account of his researches on the variation of temperature which accompanies diffusion of gases through a porous partition. The author first studied the influence of the dry or humid state of gases coming in contact with the porous wall without diffusion; next, the variation of temperature, where there is no change of pressure; and, third, where there is such a change. With constant pressure, there is a fall of temperature on the side where the denser gas is, and a rise on the other side. Each current seems to have a heating effect where it enters the porous wall, and a cooling one where it issues. With change of pressure through endosmose of a lighter gas, the temperature slightly increases, sinking again as the pressure tends to equilibrium. Where exosmose of a lighter gas causes diminution of pressure, the temperature slightly falls, subsequently rising again.—12 *A*, 1873, IX., 454.

NEW NORMAL FLAME FOR PHOTOMETRIC PURPOSES.

As a substitute for the inexact and inconvenient normal candle, Carcel lamp, etc., Professor Wartha suggests a simple apparatus for photometric observations, constructed on the following plan, by which a flame that is easily controlled, and perfectly constant for hours, may be readily produced by

the uniform consumption of a volatile organic substance of unvarying composition. A metal flask, such as is used in the liquefaction of carbonic acid by Natterer's apparatus, is partially filled with ether, and immersed in a tin vessel filled with water. The exit tube is supplied with a burner at the end, and a small water manometer on the side, intended to indicate the pressure under which the vapor reaches the burner. When the water is raised to 212°, if the quantity of ether present is sufficient, the vapor will be delivered to the burner under a constant pressure for hours, and afford a beautiful, quiet, white flame, approximating that of gas. In practice, an apparatus weighing no more than 1500 to 2000 grains could be made to resist more than double the low pressure of the vapor, and the consumption for a given time could be accurately determined to 0.015 of a grain; while by stating the size of the opening of the burner, the material of which it is composed, and the height of the flame, a flame of equal intensity, consumption, etc., could easily be reproduced and regulated. It is also suggested that such an instrument might answer for the determination of the quality and explosiveness of petroleum, and several such are being constructed adapted to various uses.—13 *C*, *March*, 1874, 307.

THE FLUORESCENCE OF AMBER.

Dr. Labert, of Breslau, states that he lately received a collection of beautiful pieces of amber from Sicily, and, on comparison with the amber from the Baltic, was struck with the great difference of color, and especially the frequency of contrasts between the surface and the inner color of the pieces. Following in the track of Brewster, Herschel, and Stokes, Dr. Labert applied the proper tests to his amber, and easily determined that both the Sicilian and the Baltic specimens notably exhibited the well-known phenomena of fluorescence. Two pieces of amber, which on the surface exhibited a beautiful blue color, showed a yellowish red color when viewed from the side; but the phenomena seemed to be subject to slight variations in each separate piece of amber. The fluorescence was much more decided in the Sicilian specimens than in those from the Baltic. He suggests, in connection with this subject, that it is well worthy of consideration whether, in the neighborhood of Sicily, there be not a sunken centre

of amber, as is supposed to have been the case in the Baltic Sea.—*Schriften Naturfor. Gesellsch., Dantzig*, III., 2.

LUMINOUS AND NON-LUMINOUS FLAMES.

It was shown by Knapp that flames may be rendered non-luminous by the addition to the illuminating gas of nitrogen, carbonic acid, or of air, and the effect was ascribed mainly to the dilution of the gas. These experiments have been extended by Blackmann, by mixing air, oxygen, nitrogen, carbonic acid, carbonic oxide, and hydrogen, in turn, with the gas, and noticing the effect upon a flame about 1½ inches high. The general results were as follows: The introduction of a gas that does not take part in combustion increases the size of the flame; the ignition takes place on the exterior only, and there is a definite degree of dilution at which combustion ceases. On the addition of oxygen, on the contrary, an interior zone of combustion manifests itself, the flame is shortened, and finally strikes down. While a flame can be rendered non-luminous by oxygen, the opposite effect can be produced by mixing this substance with the gas at the instant of combustion, which may be done externally as well as internally by allowing the two to issue from separate openings, and not affording time for uniform mixture, as in the Bunsen burner. In such a flame, if the amount of oxygen be sufficient for complete combustion, the air can take no important part, and but a small amount of inert nitrogen can be present to absorb the heat; the increased illuminating power must be ascribed to the increased temperature resulting from more concentrated combustion. The removal of the luminosity by a gas that takes no part in combustion is due, on the contrary, to the extremely dilute condition in which the gas enters into combustion, and the relatively small amount of combustible matter that comes in contact with the oxygen of the air. There is, however, a different explanation of the non-luminous character of the flame of the Bunsen burner found in the interior zone of combustion, in which a portion of the illuminating gas is consumed, while another and larger portion is converted into carbonic oxide and hydrogen, which under ordinary conditions afford a non-luminous flame; while in the other zone of combustion there is a great dilution by the products of combustion, and the nitrogen remaining from

the air that has been mixed with the gas.—19 *C, October* 25, 1873, 404.

THE PHENOMENA OF THE BLACK DROP.

The numerous observations that have been made preliminary to the approaching transit of Venus have, among other things, been quite generally directed to the explanation and exact effect of the phenomenon called "the Black Drop." This term is applied to a dark band sometimes appearing like a pear-shaped drop, which, at the beginning and the end of the transit, apparently joins together the round disk of the planet and the nearest edge of the solar disk. Bakhuyzen, of Leyden, describes an apparatus constructed by him (similar to that established by Struve, for the purpose of comparing together the observations of the Russian observers), with which he was able to reproduce, at will, the black-drop phenomena. As a result of his measures, he states that the formation and breaking up of the black drop appeared simultaneously, no matter what the size and magnifying power of the telescope. The smaller the diaphragm applied to the telescope, the broader appeared the black band; and this observation led him to the idea that the formation of this drop is in great part the result of the diffraction of the narrow band of rays of light on the edges of the object-glass, or of the diaphragms within the tube of the telescope. This idea he develops with considerable success, and is led further, theoretically, to the prediction of that which he subsequently observed accurately: namely, that small variations in the brightness of the solar disk, or in the sensitiveness of the eyes, could exert a great influence upon the apparent magnitude of the black band. Bakhuyzen also deduces a formula giving the effect of diffraction at other phases of the transit of Venus, and shows that, between the limbs of the sun and the planet, one ought to see a small dark cloud, whose brightness should be the least where the limbs of the sun and Venus are nearest to each other.—*Astron. Nach.*, LXXXIII., 306.

THE SPECIFIC HEAT OF GASES.

Amagat has undertaken to determine the ratio of the specific heats of gases under constant pressure, by a method somewhat different from that adopted by others; and which

consists in compressing a limited volume of the gas, at the pressure of the atmosphere, and determining its pressure immediately after its reduction in volume. Much ingenuity was manifested in managing the details of the process, so as to conduce to successful and accurate results; and the final number for the ratio—434—differs scarcely at all from that ordinarily accepted.—4 *D*, 1874, VII., 227.

THE MECHANICAL EQUIVALENT OF HEAT.

Fatigati has recently published a new determination of the mechanical equivalent of heat, by means of the relation which exists between the work expended to turn the disk of a Ramsden electrical machine and the electrostatic decomposition produced. To turn the disk of the machine and measure the work, he winds two strings around the handle, each passing over a pulley and carrying a weight at its extremity. He deduces from the calculated work of the falling weights, after subtracting the work consumed by friction and the work retained by the weights, the resulting amount of force converted into electricity and heat. This heat is developed by cushions, and is measured by a good mercurial thermometer and a thermo-electro pile; and the resulting equivalent in work is subtracted from the preceding calculation. Finally, the amount of electrolization is measured by means of two test tubes immersed in a large receiver containing acidulated water. The mean result of twenty-eight determinations made by Fatigati gives, for the mechanical equivalent of heat, 460.40 units of work.—7 *A*, XLVII., 155.

A NEW CONTACT THEORY OF THE GALVANIC CELL.

The well-known electrician, J. H. Fleming, has exhibited to the Physical Society of London a new galvanic battery, consisting of three test tubes of dilute nitric acid alternated with the same number of tubes of sodium-penta-sulphide; ordinary well-insulated bent strips, of alternated lead and copper, connected together the neighboring tubes. By this device the terminal poles are of the same metals—all contact of dissimilar metals being completely avoided. On connecting with a coarse galvanometer the needle was violently and permanently deflected; tested by the quadrant electrometer, the potential was shown to increase regularly with the number of cells

The principle upon which the action depends is that, in the acid, lead is positive to copper; in the sulphide, it is negative. —12 *A*, IX., 435.

SYNTHESIS BY ELECTRICAL ACTION.

Brodie, by the action of electricity, has recently performed some highly interesting syntheses. By acting upon a mixture of carbonic oxide with hydrogen he obtained a considerable quantity of marsh gas; and, with carbonic acid and hydrogen, formic acid was among the products. He also investigated the effect of electricity upon pure, dry, carbonic oxide gas. A contraction of about five cubic centimeters per hour took place, carbonic acid was formed, and at the same time a transparent reddish-brown solid deposit appeared upon the walls of his tube. This deposit proved to consist of a mixture of new oxides of carbon, apparently members of a regular homologous series, like those of the hydrocarbons. This discovery is exceedingly interesting in its bearings upon theoretical chemistry, and probably affords us the first instance in which a solid oxide of carbon has been obtained.—*Ann. Chem. and Pharm.*, *October* 4, 1873, 270.

ELECTRICAL DISTRIBUTION OF TIME BY ASTRONOMICAL OBSERVATORIES.

The system of clocks controlled by electricity by the central clock of an astronomical observatory, which was first established in England by Jones some ten years ago, has already made decided progress in this country. Not only has the apparatus for this been ordered to be constructed for the city of Cincinnati in connection with the observatory at that place, but similar apparatus has been established in Pittsburgh and Washington, and has been for some time in successful operation in those two cities. The clocks furnished these places are manufactured by Hamblet, of Boston, and in the neighborhood of this city four such clocks are in operation; they also exist in Washington, at the Capitol, the Treasury and Navy Departments, and the Army Signal-office, while at Pittsburgh a clock has been established to move the hands of seventy different clock dials scattered all over the city. By these arrangements every clock indicates exactly the same time as do the others in the circuit.—12 *A*, IX., 193.

THE ELECTRICAL RESISTANCE OF SELENIUM.

The question having been raised as to whether the phenomena observed by Mr. Willoughby Smith, as to the effect of light on the electrical resistance of selenium, could not be more properly explained as the effect of heat, and whether the selenium might not replace the thermal pile in the measurement of radiant heat, the Earl of Rosse has made an investigation; whence he concludes that we must give up all hope of selenium replacing the thermal pile, although he has nothing to say either in favor of or opposed to its applicability to photometric purposes. Selenium is, he finds, in fact, absolutely insensible to radiant heat of low refrangibility, and on two occasions he notices a diminution of the electric resistance after a certain duration of exposure to and screening from light.—7 *A*, XLVII., 161.

THE CALORIFIC EFFECTS OF OPPOSING MAGNETISMS.

Cazin states that he has observed the calorific effects which accompany the disappearance of magnetism in the core of a rectilinear magnet which has several consequent points, and has arrived at the following law, namely: When a rectilinear core of iron is magnetized by a series of identical coils through which the current passes in alternately opposite directions, if the coils determine equal concamerations, then the quantities of heat produced in the core by the disappearance of magnetism are inversely proportional to the squares of the numbers of concamerations. The experimental results arrived at by means of his delicate apparatus conform to the law of magnetic energy, which he communicated nearly two years ago, and the apparatus is sufficiently delicate to justify him in hoping that he will be able to determine the magnetic equivalent of heat.—7 *A*, XLVII., 392.

ARCHIBALD SMITH.

The death of Archibald Smith, on the 26th of December, 1872, has been followed by an obituary notice published in the Proceedings of the Royal Society for February, 1874, from which is here obtained a connected view of the very important researches which form his main contribution to science: viz., his study into the phenomena of ships' magnet-

ism. About the year 1841 his attention was drawn to this problem by his friend Major Sabine, and he shortly after published a solution of the questions connected with this subject in a form far more readily understood than had previously been given by Poisson. The formulæ of Mr. Smith supplied the means of a sufficiently exact calculation of all the laws affecting the accuracy of the compasses on board of any wooden vessel, and, when reduced to simple tabular forms, they were at once adopted by the Admiralty, and have ever since continued to be used in the royal navy. As the use of iron in vessels increased, and the weight of the armament of ships of war added to the irregularities of the compass to an inconvenient degree, an entire revision of the old Admiralty instructions became necessary, and the mathematical part of the work was intrusted to Mr. Smith. That gentleman reduced the complete expression given by Poisson, including the effect of both the permanent and the induced magnetism of the iron portions of the vessel, to a few simple and easily applied formulæ; and this last edition of the Admiralty Compass Manual has been translated into numerous languages, and adopted by the United States, and the Russian, German, Portuguese, and French governments. The rule given by Smith for placing the needles on the compass-cards has been adopted by every nation. It reads thus: "When there are two needles used, they should be placed with their ends on the compass-card at 60°, on each side of the ends of a diameter; and when there are four needles, they should be placed with their ends at 15° and 45° distance from the ends of the diameter."

The reasons given for this rule by Smith, when it was originally proposed, were afterward supplemented by various important merits which were found to be incident to this construction of the card. The general tenor of Mr. Smith's researches, as well as the result of all the experience of the British navy, seems to show that compass needles (which have sometimes attained to the monstrous length of fifteen inches, or even more, in some of the great modern passenger steamers) ought by no means to be so large as they are generally made; that, in fact, seven inches long should be the limit in length, and that if shorter than this the errors of the needle will be still more perfectly corrected. In fact, when the

needles of the standard compass are reduced to something like half an inch in length, and not till then, will the theoretical perfection and beauty, and great practical merit of Airy's method of correcting the compass be universally recognized, and have full justice done to it in practice. The studies of Archibald Smith in relation to compass deviations were carried on by him as a labor of love, entirely distinct from his practice of law. He gradually attained to an important and extensive practice, and to a high reputation as a chancery barrister, but never lost his interest in science, nor ceased to be engaged in scientific pursuits. In addition to the love of science for its own sake, he was penetrated by the conviction of the usefulness of his work; his splendid abilities, supported by a constitution of unusual vigor, were freely and heartily devoted to the service of his country and the good of his fellow-creatures. "Think how many lives it will save," was his answer to an anxious friend who begged him to relinquish labors so exhausting, and to give himself ordinary rest. His mathematical and other scientific works appear to have been entirely carried on during his vacations, his journeys, and the midnight hours stolen from sleep. During the last three years of his life he was compelled by illness to give up most of his work, but a few months before his death, having wonderfully rallied, he was engaged to revise the instructions for compass observations to be made on board the *Challenger*, then about to sail on the great voyage of scientific investigation which is still in progress.—*Proc. Royal Society*, 22.

OBSERVATIONS ON EARTH CURRENTS.

The subject of earth currents has received considerable elucidation in a discussion that is recorded in the journal of the Society of Telegraph Engineers. Mr. Winter, telegraph engineer at Madras, has established two telegraph lines, each two miles long, running respectively in the meridian and at right angles thereto, both starting from his office at Arconum, near Madras. The current from each wire was observed on the same tangent galvanometer, and observations were taken hourly during December, 1871, when bad health and press of work compelled their abandonment for a time. Apparatus for the measurement of the two elements

of these earth currents need not be of an expensive character; and it is greatly to be desired that such observations should be made in various portions of the world. Mr. Winter believes the absolute magnetism of the earth to be much more constant than is generally imagined, and that the supposed variation in its elements is largely due to the great action of the earth stream upon the magnet and magnetometers. From his observations in December, 1871, he finds the general direction of the earth current to be from the south, being most easterly at 5 P.M., and most westerly at 9 A.M.; strongest at 5 P.M., and weakest at 1 A.M. Mr. James Graves has presented to the same society a very valuable paper on the same subject. Mr. Graves was stationed, in 1871, at Valencia, during the period of nearly three months when both the cables of the Anglo-American Telegraph Company were disabled. During this interval of seventy-eight days he embraced the opportunity of recording, every half-hour, the nature and strength of the earth currents that were manifested upon these wires; one cable being about 1850 and the other 1820 nautical miles in length. The record for the two cables was practically the same. The recorded deflections of the galvanometer needles have been reduced to relative values in terms of one battery cell as a unit of force. He shows that there are two maxima of force positive, and two negative; the first maximum positive at 3 or 4 A.M.; the first negative at 7 or 8 A.M.; the second and larger maximum positive about 12 or 1 P.M.; and the second maximum negative at 6 or 7 P.M. The maximum observed at any time was equal to 112 cells during an aurora, at 10 P.M., April 9. Great meteorological changes, as well as sudden changes of wind, are, he finds, generally accompanied by an earth current of unusual force. The currents repeatedly reverse from plus to minus, and *vice versa*, during the display of auroras, precisely as when a short cable or land-wire is used. Whenever an earthquake is experienced in any part of the globe, the telegraph lines are more than usually influenced by earth currents, and Mr. Graves has observed the same with reference to the ocean cables, showing that the great internal convulsions of the earth give rise to electrical currents.—*Jour. Soc. Tel. Engineers*, II., 89.

THE MAGNETIZATION OF GLASS.

An interesting paper in Poggendorf's *Annalen*, by Professor Villari, treats of the time that flint-glass takes to be magnetized, demagnetized, and to turn the plane of polarization. He rotated a glass cylinder between the poles of an electro-magnet, where it acted like a cylindrical lens with polarized light passing through the poles. When not magnetized, the cylinder, whether in motion or at rest, was neutral to the light; but when magnetized, its plane rotating power diminished considerably with increasing velocity of rotation; the reason being that, in such quick revolution, each diameter remained too short a time in the axial direction to receive all the magnetism it would otherwise have acquired. To give flint-glass such diamagnetic intensity as became observable by rotation of the plane required at least one eight-hundredth of a second of time; while to give it all the diamagnetism it is capable of taking under a strong magnet, at least one four-hundredth of a second was needed.—12 *A*, 1873, IX., 94.

THE MAGNETISM OF ELECTRO-MAGNETS.

M. Gaugain, as the conclusion of an extensive investigation into the construction of electro-magnets, states that, in order to explain his observations, it is necessary to conclude that a bar of iron contains two shells as it were of positive magnetism, separated by a layer of negative magnetism. One can easily see how to superpose a greater or less number of layers, alternately positive and negative, by passing through the coils of the electro-magnet a moderate number of alternately positive and negative currents of diminishing intensity, the law of diminution not being a matter of chance. It is, however, necessary that the intensity of the induced current should decrease with a definite rapidity. When this intensity diminishes too slowly, the iron which is submitted to its influence is in the same state as if it had been submitted only to the influence of a current feebler than that which has been employed. It is then feebly magnetized, and, if subjected to the action of a current of greater intensity, it is magnetized equally in both the positive and negative senses. It then behaves as if it were really in a neutral state. Consequently,

whenever, in the course of his researches, Gaugain desires to demagnetize a bar of iron, he submits it to the action of a series of alternating currents whose intensity decreases gradually and slowly. He supposes that the same method would serve to demagnetize steel.—6 *B*, *November*, 1873, 704.

SECULAR CHANGES IN THE EARTH'S MAGNETISM.

Mr. Schott, of the Coast Survey, has made an examination of the secular changes in the magnetic elements, based on all the observations taken at Washington since 1790. He finds that the magnetic declination varies in a periodical manner, such as will cause it to return to its present value in about two hundred and forty years. The dip of the needle is now slowly diminishing, and has continued to do so since 1840, its annual change being very nearly uniform. The total magnetic force is very slowly increasing, although at present it is sensibly nearly stationary; it reached its minimum about twenty-two years ago, and, after having increased until the present time, is probably now about to diminish. The hypothesis that the observed secular changes are the effect of thermal changes in the earth's crust, manifesting themselves as a disturbance in the distribution of terrestrial magnetism, seems to the author a plausible one. These thermal changes must be considered to have a slow rate; but operating on a vast scale, explaining the similarity of secular change extending over thousands of miles, and going on, perhaps, for hundreds of years. They appear to be of a mixed, progressive, and periodic character. Thus the influence which produced the increase of the magnetic west declination on our Atlantic coast was first recognized in the Northeast, extending itself in time toward the Southwest.—*Report of the United States Coast Survey*, 1870, *Appendix*, No. 14.

MOLECULAR THEORY OF MAGNETISM.

Mr. George Gore has communicated to the Royal Society his conclusions in reference to the question as to whether, in the case of two parallel wires conveying electric currents, the attractions and repulsions are between the currents themselves, or the substances conveying them; and he concludes that these forces are not exerted between the currents,

but between the wires themselves. It is evident, he states, that, as every molecular disturbance produces an electric alteration, so, conversely, every electric current passing near or through a substance produces a molecular change; a change that is conspicuously shown by the phenomena of electro-torsion, lately discovered by him. The molecular changes referred to last as long as the current does; thus a rod of iron, when under the influence of an electric current, emits a different sound, when struck, from that emitted by it when the current ceases. The electric repulsion must, he concludes, be due to a direction of structure different from that which obtains when electric attraction is observed, and he would propose to substitute this view for the theory of Ampère, as ordinarily accepted. According to this new theory, a magnet, like a spring, is not a source of power, but only an arrangement for storing it up, the power being retained by some internal disposition of its particles, acting like a ratchet, and termed coercive power. According, also, to this view, any method which produces the requisite direction of structure in a body will impart to it magnetic properties; thus a crystal of cyanite possesses the property, while freely suspended, of pointing north and south by the directive influence of terrestrial magnetism; and one of stanite points east and west under the same conditions.—12 *A*, 1874, IX., 434.

NEW MAGNETIC CHART OF THE NORTHERN HEMISPHERE.

To many of our readers the question will have often recurred as to what has been done with the great mass of observations bearing on terrestrial magnetism made in connection with the Magnetic Survey which was so laboriously carried on from 1840 to 1845. Few besides those acquainted with the subject, however, are aware that for nearly forty years Sir Edward Sabine has devoted himself (assisted, we must not fail to say, by his wife) to the computations and investigations needed in order to properly utilize the mass of observations accumulated during these five years. From time to time, of late years, a contribution to terrestrial magnetism has issued from his pen, and the last of these (No. 13) has just been received in this country, bearing the title of "The Magnetic Survey of the North Polar Regions of the Globe."

This is regarded as a companion to the "Magnetic Survey of the South Polar Regions," published five years ago. The present work differs from its companion in having been executed by the authority of a single nation and at the national expense, and completed in the interval between the years 1840–45, and thus requiring no corrections for secular changes, while these corrections are an important feature in the earlier communication, which comprehends the labors of many nations between the years 1820–65. The earliest conclusion of a systematic character regarding the phenomena of terrestrial magnetism, and which has been borne out by our recent knowledge, is that of Halley, in 1663, who concluded that the globe of the earth may be regarded as one great magnet, having four magnetic poles or points of attraction, two of them near each pole of the earth, and two in those parts which do not lie near either of those poles, the needle being governed by the strongest pole, or being always predominant over the weaker. The next step in our knowledge was marked by the publication of Hansteen's work, "*Der Magnetismus der Erde*," which brought together systematically all known observations of the magnetic declination, and formed from them maps of the phenomena corresponding to successive epochs. The present contribution is a continuation in the same direction; but the amount of new material which has accumulated since the publication of Hansteen's work, in 1819, shows the increasing interest in this subject, and may be regarded as constituting an era in the history of its progressive advance. The earliest authoritative knowledge we possess of the magnetic state of North America was contained in the same communication from Halley above referred to, in 1663, at which time the North American pole was stated by him to be in the meridian corresponding with the middle of California, and about 15° from the north pole of the globe. The latest determination—that of Sir Edward Sabine, as given in his present communication—places the maximum of magnetic inclination in latitude 70° north, and longitude 263° east, while the maximum of magnetic force is in latitude 53° north, and longitude 268° east, both localities being to the east and a little to the south of the geographical position which Halley assigned to the magnetic pole in 1663. The elaborate maps of the northern regions accompanying the

memoir of Sir Edward Sabine show that the second pole of magnetic force of the northern hemisphere is situated in the eastern portion of the Asiatic continent, probably not far from the centre of China.—*Trans. Royal Society*, 1873, 353.

THE NEW MARINE COMPASSES OF MESSRS. RITCHIE & SONS.

According to the recent annual report of the Secretary of the Navy, the liquid compass manufactured by Messrs. Ritchie & Sons, of Boston, is not only sound in principle, but convenient and reliable in use, satisfying the three fundamental desiderata of sufficient magnetic power, great stability or steadiness, and extreme sensibility. In the first particular, only, does Professor Greene report that it possibly admits of being improved. In the compasses now manufactured under his supervision, a new card-circle has been devised, insuring greater precision in all the details of the formation of the compass-card itself. Two card magnets are permanently attached to the compass-card. The weight pressing upon the pivot is only about fifty grains at the mean temperature; but even with this there is an appreciable wear of the agate bearings, and it is proposed to test the use of sapphire instead of agate. The azimuth circles are so made that they are interchangeable upon every bowl of the same class, but, in spite of the attention given to all the details of the compass, there must be accurate, reliable tests of the actual condition of the instrument when completed; otherwise no certainty can be had as to the excellence of its performance.—*Report of the Secretary of the Navy*, 1873, p. 80.

COMPASS DEVIATIONS.

Among the additions to the Bureau of Navigation of the Navy Department at Washington has been the construction of a compass observatory, under the direction of B. F. Greene, who was recently appointed professor of mathematics and made superintendent of compasses. The important matter of the deviation of the compasses on board of both iron and wooden vessels has undoubtedly been too much neglected in this country, although its importance has long been fully recognized, first of all in England and France, and later also in Australia, Russia, and Germany. In a previous volume of the *Annual Record* will be found a notice of the memoir of Pro-

fessor Harkness, of the Naval Observatory, containing the results of an investigation made by him into the magnetic condition of the *Miantonomah*, a study that was prosecuted during the entire period of the voyage of that monitor from New York, around Cape Horn, to San Francisco. In order to test all the compasses used by the navy, a compass observatory has been erected at Brookline, Mass.; the building being constructed at the expense of Mr. Ritchie, while the Bureau of Navigation lends the requisite instruments. The building thus provided is situated at least one hundred feet distant from any other structure, and has been carefully and thoroughly built, without the use of magnetic material in any part of it. The whole arrangement is essentially the same as that used for the examination of the compasses of the British Admiralty. An important part of the duties assigned to Professor Greene has reference to the determination of the deviation of the compass, and the modifications of its magnetic force, that are due to the action of the ship's iron. For several years past the ships of war have generally been "swung" before going to sea, for the determination of the compass deviations. Nearly all our sea-going ships have wooden hulls, and the magnetic perturbations are, therefore, of but slight account; but now it is proposed to extend these observations to all iron-built ships, whence the requisite data will soon be acquired for investigating the peculiarities of these vessels, and the variations in the same depending upon the movement of the ship from one portion of the globe to the other.

In June last Professor Greene examined, on the Northern lakes, the United States steamer *Michigan*, which is the oldest iron-built ship in the navy. With reference to this vessel, he concludes that, in general, there is a marked difference between the variations of the fore-compass and the after-compass, being in one of the compasses a minimum when the vessel heads northerly, and a maximum when it heads southerly, while they are the reverse at the other compass. The polar magnetism of the ship is very nearly symmetrical with the midship or fore and aft section. The influence of the iron steam-cutter is unimportant. The original polar magnetism of the *Michigan*, as developed while she was being built, can not be very exactly investigated; but he concludes that, in general, the original direction of the permanent magnetism

was through her starboard bow and port quarter; and it appears to be probable that this permanent magnetism now continues to have its direction not very different from what it was originally, suggesting a remarkable stability; which is not altogether improbable, in view of the admirable quality of the iron in the hull of the vessel.—*Report of the Secretary of the Navy*, 1873, p. 80.

VARIATION IN MAGNETIC DECLINATION.

Wolf, in the thirty-fifth number of his Astronomical Notices, has endeavored to demonstrate that, at least for Europe, the variation in magnetic declination at any place is very accurately represented by a certain constant, plus as many minutes of arc as are equal to the number found by taking four and a half per cent. of the numbers published by him as representing the relative frequency of solar spots for any given year. These constants are given by him for twenty-six places in Europe and America. Thus, for instance, at Philadelphia the variation of magnetic declination is represented by $6.88' + 4\frac{1}{2}$ per cent. of Wolf's solar-spot-frequency number for any given year.—*Astron. Nach.*, LXXXIII., 286.

EFFECT OF FOG ON SOUND.

Professor Reynolds, of Manchester, endeavors to explain the fact that sound does not readily penetrate fog. He shows that the particles of water do not, as it has sometimes been supposed, break up the waves of sound by small reflections in the same way as they scatter the waves of light, but that the destruction of sound is due to the fact that when foggy air is accelerated or retarded, the drops of water move through the air, and expend energy in fluid friction. He examines, further, the relation between the size of the drops and their effects. He finds, in the first place, that if the air is subjected to a uniform acceleration, then the energy dissipated by the drops in a given time is proportional to the square root of the diameter of the drops. Starting with drops the size of rain, their effect will increase as their size diminishes, at first in the direct proportion, then more and more slowly until a certain minuteness is reached, after which, as the drops become still smaller, their effect will begin to diminish, at first slowly, but in an increasing ratio, tending to

ward that of the square root of the diameter of the drops. It thus appears that, for any note of waves of sound, there is a certain size of drop with which a fog will produce the greatest effects.—12 *A*, IX., 216.

VIBRATIONS OF LIQUID SURFACES.

The undulations which are produced upon liquid surfaces when a heavy tuning-fork is brought into contact with the vessel containing the liquid have been investigated by Barthelemy. He observed the phenomena by allowing a beam of sunlight reflected from the liquid surface to fall upon a screen. Barthelemy deduces the two following laws for rectangular vessels: First, that the breadth of the undulations is inversely as the number of vibrations; and, second, that the distance between two lines produced by the same tuning-fork is independent of the density of the liquid. The author calls attention to the general resemblance of these wave surfaces in the basin of a fountain to the waves of the sea; even in the sand on the sea-beach they may be recognized; so also clouds are arranged often in parallel bands, and an ingenious application of these facts accounts for the phenomena of stratification produced by electric discharges in rarefied media.—4 *D*, VII., 1874, 590.

ACOUSTIC TRANSPARENCY OF THE ATMOSPHERE.

Professor Tyndall, as the official adviser of the older brethren of the Trinity House, has under their auspices investigated the audibility at great distances of fog-signals at the stations Dover and South Foreland. Fog-horns, fog-whistles, and the siren were employed to give the signals, each being worked by a steam-engine. Artillery discharges were also employed as signals. The variation in the audibility of the sounds at distances varying from one half of a mile to three miles was very remarkable. A sudden acoustic darkness would seem at times to settle upon the atmosphere. Days that were perfectly clear optically were sometimes the most impenetrable to sounds. Professor Tyndall remarks that there may be states of the atmosphere associated with rain that are unfavorable to sound, but to rain itself he has never been able to trace the slightest deadening effect. On certain days of foggy weather, both over the ocean and also in the city of

London, they were heard with great distinctness, while immediately on the clearing away of the fog the sounds fell to perhaps one fourth of their intensity. Professor Tyndall concludes that the reflection and refraction of sounds, by a mixture of cold and warm currents in the atmosphere, sufficiently explains all the phenomena observed by him, and this view is to a considerable extent confirmed by an experiment devised by his assistant, Mr. Cottrell, who constructed an apparatus by means of which twenty-five flat layers of hydrogen are alternated with twenty-five layers of carbonic-acid gas. Through this mixture of gases of different densities no sound sufficient to affect the most sensitive flames was able to pass.—12 *A*, IX., 250, 267.

THE WIDTH OF THE SPECTRUM LINES.

Lord Rayleigh states that in the explanation usually given of the increase of width of the spectrum lines with increased pressure, it appears to be assumed that their finite width depends upon the disturbance produced by the mutual influence of the colliding molecules. He demonstrates, however, that the resulting lines must have a finite width, in consequence of the motion of the molecules in the line of sight. If there is any truth at all in the Kinetic theory of gases, the molecules of a glowing substance are moving in all directions indifferently, and with velocities whose magnitudes cluster around a certain mean. The wave length of the light emitted by the molecule, moving with a mean velocity from the eye, will therefore be greater by about five millionths than if the molecules were at rest; and the double of this will be a moderate estimate of the width of the spectrum line; whence Rayleigh concludes that however rare the gas, and however perfect our instruments may be, a fixed line can not be reduced to within narrower limits than about the hundredth part of the interval between the sodium lines.—12 *A*. 1873, 475.

IMPROVED FORM OF ELECTRIC LIGHT.

A great improvement upon the old form of the electric light has lately been brought forward in Russia, and, according to the journal of the Society of Arts, one that is all that is necessary to warrant the general use of this mode of illumination,

being very economical, and applicable for a great many purposes from which it is now debarred on account of its uncertainty and want of precision. By the old method the electric current was passed between two points of charcoal, each attached to a copper wire connected with an electro-magnetic machine. The disadvantages of this arrangement were that a separate machine was required for each light, and these were very difficult, if not impossible, of regulation, and liable to constant interruption, owing to the rapid consumption of the charcoal points from exposure to air.

By the newly invented method of Mr. Ladiguin, only one piece of charcoal or other bad conductor is required, which, being attached to a wire connected with an electro-magnetic machine, is placed in a glass tube, from which the air is exhausted, and replaced by a gas which, even at a high temperature, will not combine chemically with the charcoal. This tube is then hermetically sealed, and the machine being set in motion by means of a small steam-engine, the charcoal becomes gradually and equally heated, and emits a soft, steady, and continuous light, which, by a most simple contrivance, can be strengthened or weakened at the option of those employing it, its duration being dependent solely on the electric current, which, of course, will last as long as the machine is kept in motion.

Taking into consideration the fact that one machine, worked by a small three-horse-power engine, is capable of lighting many hundreds of lanterns, it is evident what an enormous advantage and profit could be gained by the illumination of streets, private houses, public buildings, and mines with the new electric light. In the latter it must prove invaluable, as no explosion need ever be feared from it; and these lanterns will burn equally as well under water as in a room.

Without mentioning the many advantages this mode of illumination has over gas, which, by its unpleasant odor and evaporation, is slowly poisoning thousands of human beings, and from which explosions are frequent, we can state that, by calculations made, this electric light can be produced at a fifth of the cost of coal gas.

The journal of the Society of Arts promises soon to place before the public more complete particulars of this great im-

provement, as well as notices of experiments about to be made in Vienna, Paris, and London.—23 *A*, *August* 22, 1873, 779.

LIGHT OBSERVED IN GRINDING HARD STONES.

At the agate-polishing establishments in Oldenburg, a phenomenon has been observed for the past century that has as yet, perhaps, attracted too little attention from scientific men. Under very powerful friction, such as can only be produced by the machinery at those works, hard stones become splendidly luminous and transparent throughout. In this establishment the axis of an undershot water-wheel reaches into the grinding-room, where four or five grindstones rotate vertically; over each is brought a gutter, so that a constant small stream of water pours upon the stone. The grindstones themselves are entirely faultless. They are about five feet in diameter, and make three revolutions in a second, so that the grinding surface that passes the object pressed against it amounts to thirty-two English miles per hour. When grinding, the workman lies on his belly, his chest on a semicylindrical hollowed stool, his feet stretched out behind, braced against a post fixed in the floor. With both hands he presses the stone to be polished firmly against the grindstone, bringing his whole weight to bear upon it. The muscular strength brought to bear is very great, and the work is performed with intermissions of equal times of rest and work. Some experiments were made in this workshop by Noggerath in broad daylight. He observed that as long as a stone of the hardness of quartz was pressed against the revolving grindstone there was produced an intense red light, which at the same time radiated around the object and emitted numerous sparks. This experience was the same with all hard stones, which appear almost like red-hot iron, and it really looks as if the hands must be severely burned. All the stones became warm in grinding, but not very hot. Chalcedony gave a magnificent fiery red light; chrysoprase a feeble red light; rock crystal a beautiful rose red; coralline a superb red light, the color being evidently increased by the natural hue of the stone. Amethyst gave a pale violet, while numerous opaque stones gave no light at all.—7 *A*, XLVII, 237.

THE FORMATION OF "GLORIES."

If one contemplates his shadow in full sunshine as thrown upon any rough surface, especially upon the dew-drops covering a field of grass, the shadow of the head will be seen surrounded by a feeble halo of light, which ordinarily extends above the head further than on either side. Of several observers standing side by side, of course each one sees only his own shadow surrounded by this glory. Similar phenomena have been observed by aeronauts when their shadows are thrown down upon the upper surface of the clouds. The explanation of these phenomena has been sought by Lommel, who concludes that the "glory" consists of rays of light, which, entering into the drops of dew or fog or rain, are refracted and reflected from the further surface of the drop, and finally return to the source of light. These rays have, therefore, suffered one reflection and four refractions; in other words, the phenomena are caused in the same way as the shining of the eyes of cats and other animals which have a strongly reflecting surface at the back of the eye. In case of large rain-drops, the phenomenon appears only when these lie, like dew-drops, upon the surface of the leaves, and, by virtue of their rounded form, act like small lenses.—19 *C*, 1874, 146.

EXPANSION OF EBONITE BY HEAT.

Kohlrausch, having accidentally observed that ebonite lids stick fast in glass vessels, suspected that this material might have a considerable expansibility by heat, and his expectation has been realized by finding that it is about three times as expansible as zinc. This great expansion may possibly be connected with the proportion of sulphur which ebonite contains. On the other hand, the contrast with soft caoutchouc is remarkable. The increase of the co-efficient of expansion with temperature is very considerable. One fact is mentioned relating to the expansion which seems to be of peculiar value. The bar of ebonite, which was about a centimeter in thickness, after being heated, required some time before it assumed a constant length. Although the bad conductivity is doubtless the principal cause of this, the author thinks that another agent also is at work. Like the elastic change of

form, so the expansion by heat may not take place instantly, but continue itself after the change of temperature. A few observations with glass rods, by Matthiesen, seem to point in this direction. Probably this thermal after-action, like the elastic, occurs in an eminent degree in organic substances.—7 *A*, XLVII., 157.

THE TRUE ZERO POINT OF THE CENTIGRADE THERMOMETER.

Dr. Craig, in a communication to the *American Chemist*, calls attention to the fact that the true zero point of the Centigrade, or 32° of the Fahrenheit scale, is not that of the freezing-point of water, but the melting-point of ice, and that water in which even a considerable quantity of ice is immersed is usually several degrees above this point. If, however, the bulb and stem be immersed in melting ice or snow, from which the water is draining off as it is produced, the mercury will attain the exact temperature desired. Dr. Craig further remarks that any vessel filled with damp snow will give correct results, if the instrument is driven down in the snow up to the 32° point, and a lens is placed on the top of the snow to read by, provided there is no accumulation of water about the bulb. He also refers to the fact that there is a gradual change in the scale of the thermometer with age, the reading becoming generally too high. This is due to the contraction which in time takes place in the bulb, although occasionally there may be temporary changes in the opposite direction.—1 *A*, *July* 24, 1874, 33.

THE EFFECT OF LIGHTNING ON TREES.

The theory that the splitting of the trunks of trees by lightning is the result of the sudden evaporation of the liquids contained within them has received much confirmation from experiments made by Osborn Reynolds, who succeeded in splitting small sticks of wood by passing the electric spark through them after they had been impregnated with water. He also burst small glass tubes which were filled with water, although the same tubes, when empty, allowed the electric spark to jump through them without in the least disturbing them. The most striking experiment made by him was upon a tube three eighths of an inch exterior and one eighth interior diameter, which could stand a pressure of at least two

hundred atmospheres to the square inch; this tube was fourteen inches long, and bent at a right angle. A very large electric flash being sent through the tube, it was split by the first discharge, and the pieces thrown to a distance of several feet. The inner surface of the tube was, in fact, completely pulverized, as though it had been struck by a hammer. Reynolds estimates that the pressure must have been more than one thousand atmospheres.—19 *C*, 1874, 147.

MEASUREMENT OF GALVANIC CURRENTS.

Mr. Latimer Clark states, in reference to a common source of error in the measurement of currents of short duration, that, when using galvanometers with shunts, a certain discrepancy has been noticed, which is usually attributed to some peculiarity of the vibration of the needle of the galvanometer, and on endeavoring to ascertain the cause of this discrepancy, he discovered that the results given by the use of resistance coils were correct, and that those obtained by the use of condensers were wrong. The cause of the error he traces up to the fact that the movement of a magnetic needle tends to induce in the coil within which it is suspended a current in the opposite direction to that producing its deflection. A larger proportion of the whole current consequently passes by the shunt, which is not subject to the influence of the needle. If, therefore, two galvanometers are used, the movements of the needles within their coils being similar, each of them counteracts the other's influence, thus concealing the errors of the process. This source of error does not exist when the measure is made by a differential galvanometer. De Sauty's method of comparing measures is also free from this source of error, and, in general, he concludes that it is better, in testing submarine cables, to avoid the use of condensers for comparing batteries with standard cells, and to make use rather of very high resistance coils; and he has generally recommended the use of a resistance as high as two hundred and fifty thousand ohms.—*Journal Soc. Tel. Engineers*, II., 16.

THE CONDUCTIVITY OF METALLIC VAPORS FOR ELECTRICITY.

The conductivity of flame for galvanic currents is known to be greatly exalted by the presence of metallic vapors, and

Herwig has been led to inquire whether a gaseous layer entirely formed of such vapors will not show good conductivity even at low temperatures. He experimented with mercury, dense vapors of which can be used several hundred degrees under white heat. He finds the vapor conductor to resemble that of the voltaic rather than that of a simple metallic conductor. There is a peculiar transition resistance which is great in comparison with the hinderances which the current finds within the vapor layer itself, so that the total resistance is in great measure independent of the extent of the vapor layer. The transition resistance is less with increased electro-motive force of battery or strength of current. The vaporization at electrode in the positive mercury surface is increased by the current, an effect similar to that noticed in the voltaic arc, in which, if the electrodes be mercury and platinum, the mercury is vaporized only when it forms the positive pole. Using a platinum point and a mercury surface, Herwig finds the resistance of the vapor greater when the mercury surface is positive.—12 *A*, X., 154.

MOLECULAR CHANGES IN IRON WITH VARIATIONS OF TEMPERATURE.

Professor Thurston, of the Stevens Technological Institute, has made an important observation in regard to molecular changes produced in iron by the variations of temperature. He comes to the conclusion that, at temperatures above 600° Fahr., and below 700°, iron conforms to the general law for solid bodies; that increase of temperature diminishes the tenacity, but increases the ductility and resilience, while decrease of temperature has the opposite effect. Below 700° the tenacity increases with diminishing temperature, while the resilience decreases in a much higher ratio. Between ordinary temperatures and a point somewhere between 500° and 600°, on the other hand, iron shows a marked deviation from the law, the strength increasing to the extent of about fifteen per cent. with good iron. The practical result is that, as iron does not lose its power of sustaining steady loads at a low temperature, but greatly loses its power of resisting shocks, the factor of safety in structures need not be increased in the former case where exposure to severe cold is apprehended; but that machinery, rails, and other structures which

have to resist shocks, should have large factors of safety, and be protected, if possible, from extremes of temperature.

THE EFFECT OF A GALVANIC CURRENT ON THE ELASTICITY AND LENGTH OF THE CONDUCTING WIRE.

As the result of a very complete investigation by Streintz into the effect of a galvanic current on the elasticity and length of the wire through which it is passing, the author gives the following conclusions:

1. The current does effect a change in the elasticity of its conducting wire, but only by virtue of the heat that is thereby developed.
2. The current extends the conducting wire more than it would be extended by simply warming up to the same temperature. Such excess of extension is inappreciable only in the case of hard steel.
3. The galvanic extension is effected, not suddenly, in consequence of the completion of the current, but gradually, in a manner similar to the effect produced by heat.
4. The galvanic extension can not be a consequence of an electro-dynamic repulsion, but probably consists of a polarization of the heat vibrations.—*Sitz. K. K. Akad. der Wiss., Wien*, LXVII., 354.

THE HORIZONTAL PENDULUM.

Zöllner describes a series of experiments, with a form of horizontal pendulum, of such surprising delicacy that it opens a wide field for investigation. It has, indeed, been shown that the instrument suggested by Zöllner was described, and its uses suggested, in the early part of the present century, by Gruithuisen, whose account, however, had quite fallen into oblivion until Zöllner's reinvention of the same delicate instrument. The apparatus consists of a short horizontal lever, suspended from a fixed point A by a vertical piece of fine watch-spring attached near one end of the lever, and carrying at the long end a heavy leaden weight and mirror. The short end is prevented from rising by a second watch-spring fastened to the ground below at a point B. The two points A and B are nearly vertically above each other, and are equidistant from the lever; they may be so adjusted that the pendulum will assume a position of equilibrium, around

which it will vibrate if disturbed; acting, in fact, precisely like a common pendulum, except that the effect of gravity has been greatly diminished, so that the time of vibration is increased. In the instrument actually observed by Zöllner the horizontal lever vibrated once in about fifteen seconds when in its horizontal position; whereas, if removed from its supports, and vibrated vertically like a common pendulum, it would have required a quarter of a second only. The instrument was so susceptible to disturbing influences that it was set in motion by a railway train passing at a distance of about a mile. Zöllner has suggested, as did Gruithuisen before him, that it may be possible by means of this instrument to determine directly the attraction of the sun and moon upon it, and hence to determine their distances. It may even afford a means of measuring the time required by gravity to pass from the sun to the earth. —4 *D*, 1874, VII., 126.

ELECTRO-TORSION.

Mr. George Gore has shown that a rod may be brought under the influence of electric currents in such a way as to experience a twist amounting to as much as a quarter of a circle. This twist is always attended by the emission of sound, and is produced by the combined influence of heliacal and axial currents of electricity, one current passing through a long copper wire surrounding the bar, and the other in an axial direction through the bar itself. The result is explained as due to the combined influence of the magnetism induced in the bar by the coil current, and of the transverse magnetism induced in it by the axial one. The current flowing from a north to a south pole produces left-handed torsion; a reverse one, right-handed torsion, *i. e.*, in the direction of an ordinary screw.—4 *D*, VII., 419.

ELASTIC REACTION BY TORSION.

From a communication by Dr. Nessen, presented to the Academy of Sciences of Berlin by Helmholtz, it appears that the former has been investigating the reaction observed after twisting a string of India rubber. This substance is peculiarly interesting, because of its remarkable combination of the properties of viscosity and elasticity. The observations of

Dr. Nessen, made with an apparatus of considerable delicacy, lead to results somewhat different from those of Kohlrausch. He finds the strings observed to be highly susceptible to the least radiation of warmth; but, avoiding this source of error, he concludes that the elastic reaction in the case of torsion follows the law expressed by a simple exponential curve. The magnitude of the reaction increases with the diminution of temperature, as also with increasing angle of torsion, and with increasing duration of time. The co-efficient of elastic reaction increases with increasing temperature only, being independent of the extent of the duration of the torsion.—*Monatsbericht K. P. Akad. Wiss., Berlin, February*, 1874, 141.

THE EVAPORATION OF LIQUIDS.

Stefan has endeavored to reduce to some definite laws the phenomena of the evaporation of liquids (especially the diffusion of vapors), and has made a series of experiments, principally on the evaporation of ether. He finds that in narrow open tubes the velocity of the evaporation is inversely proportional to the distance of the surface of the liquid from the open end of the tube. It is independent of the diameter of the tube, and increases with the temperature, so far as the vapor pressure increases with the temperature. If the pressure of the vapor becomes equal to that of the air, the formula given by Stefan shows that the liquid then boils. If the evaporation takes place in closed tubes, bubbles form and issue, continually, at such a rate that the times in which equal numbers of bubbles form are proportional to the numbers 3, 5, 7, etc. If the tube contains hydrogen instead of air, the bubbles form in one fourth of the time; or, in other words, evaporation proceeds four times as rapidly in hydrogen as in air.—4 *D*, 1874, VII., 142.

THE DISAGGREGATION OF TIN BY CONCUSSIONS.

One of our former contemporaries records as a great rarity a curious case of the disaggregation (or disintegration) of metallic tin. The facts of the case are as follows: A commercial house at Rotterdam had dispatched a quantity of tin in form of pigs, by railway, during a hard frost. It arrived at its destination as a powder composed of large crystalline grains. Its appearance was so unlike that of tin of

good quality that an examination of its composition was undertaken, which resulted in showing that it was almost absolutely pure tin, containing less than three per cent. of foreign substances (lead and iron). It was found to be impossible to reunite by fusion the metal so curiously divided, for, in the attempt, it gave rise to such a quantity of oxide of tin that the product was nothing better than a gray powder. The explanation offered to account for this case is that the disaggregation of the metal was the result of the combined influences of cold and vibration. It should, however, be said that the phenomenon is by no means an exceptional or isolated one, several analogous cases having been quite recently reported. The explanation above suggested seems, in the absence of a thorough investigation, to be at least reasonable, and places the case in the same category with the molecular changes which are frequently known to occur with other metals when exposed to long-continued vibration.

CRYSTALLINE STRUCTURE PRODUCED BY CONCUSSION.

Professor Thurston, in his researches on the behavior of metals under strain, presents the following statements concerning the physical texture of metals and its relation to predicable causes. A kind of fracture which is probably always indicative of brittleness is generally, and possibly correctly, termed crystalline. It is supposed to be caused by a long-continued succession of shocks, which, straining the metal to the elastic limit, permit the crystalline grouping of the molecules to take place. Dr. Percy, one of the leading metallurgists of the world, seems to have been fully convinced of the possibility of the formation of true crystals in this way; but direct experiment is still desirable fully to determine it. Professor Thurston then details the following striking, though accidental, occurrence, which affords, in the most satisfactory manner, the experimental verification desired: A singular instance of this peculiar molecular action recently occurred at the Morgan Iron Works in New York. While a powerful steam-hammer was at work upon the red-hot end of a shaft, originally designed for the engines of a large naval steamer, a piece of the opposite end, which was cold, and which was supposed to be strong enough to transmit several thousand horse-power, dropped off. This was an

extraordinary event, but not unprecedented. In all such instances the fracture seems to follow a plane passing through a comparatively sharp angle at the side of a collar, or at the end of a journal.

ATOMIC HEAT.

Professor F. W. Clark, the author of the table of physical constants recently published by the Smithsonian Institution, states that he is now compiling a table of the atomic heats, so called, and that, in the course of a comparison of over four hundred values, he has found that while, on the one hand, the laws of Dulong and Petit are approximately verified (namely, that the atomic heats of atoms are constant), yet, on the other hand, the deviations from this law are also worthy of notice; inasmuch as if we arrange any group of allied substances in the order of their molecular weights, we at once find the deviations from the approximate law to be themselves governed by the simple rule that they are greater in proportion to the increase in the atomic weights. It follows, therefore, that if the bodies in question could have their specific heats determined under similar circumstances, *i. e.*, at corresponding temperatures above their own individual boiling-points, we should derive numbers much more nearly constant than those now accepted.—*Bulletin of the Phil. Soc. of Washington.*

THE EFFECT OF GALVANISM ON A MAGNETIZED WIRE.

As the result of some preliminary experiments on a magnetized copper wire, Professor Balfour Stewart states that when a galvanic current passes through a magnetized wire there is a first effect in the direction of increased resistance, which appears to have reference to three things, namely, the previous state of the wire, the solidity of the circuit, and its magnetization. In the second place, we have an average effect, apparently exhibited in a decreased resistance, while the magnetism is on, without reference to the direction of the magnetism. In the third place, when in a solid circuit the direction of the magnetism has been recently changed, there appears to be a temporary reversal of the average effect, which appears at first as an increase of resistance. Fourth, we have also some evidence that a copper wire, one end of

which is wound around the pole of the magnet, changes its position in the electro-motive series.—12 *A*, X., 1874, 97.

THE VARIABILITY OF SPECTRA.

The variability of the spectra of glowing gases has lately been studied by Schenck, who finds that this is affected by the following circumstances: viz., by the density of the gas; the strength of the galvanic current that heats it, as well as the method of electric discharge, and the changes of temperature that are produced thereby; the thickness of the glowing stratum of gas; and, finally, the chemical purity of the gas. With regard to the density of the gas, it is found that the diminution of density causes the spectrum to become fainter and fainter, and leads to a change in the relative position of certain of the bright lines, which sometimes will at last become broad bands. When the highest possible degree of rarefaction is reached, it is found that the bands respectively become groups of well-defined lines that are occasionally merged into each other.—7 *C*, X., IV., 244.

THE CONNECTION BETWEEN SOLAR ECLIPSES AND TERRESTRIAL MAGNETISM.

The question as to whether the magnetism of the earth is influenced by a solar eclipse has lately been the subject of a thorough discussion by Denza, who concludes that, from his own and other observations, it follows that the hypotheses and the theories that have been suggested by various persons as to the combined influence of the sun and moon on terrestrial magnetism, whether they relate to eclipses or to the ordinary conjunctions of these two celestial bodies, have no value; and that the connection between these two series of cosmical phenomena is in no wise proved through any observations that have thus far been made.—19 *C*, 1874, 130.

EARTH CURRENTS.

A number of valuable contributions to the subject of earth currents have lately been published in the journal of the London Society of Telegraph Engineers, from which we make a few extracts. It seems that not only are auroras accompanied by remarkable electric currents in telegraph lines, which appear to owe their origin to a difference in the electric con-

dition of the earth at the two ends of the line, but even earthquakes are also frequently accompanied by similar phenomena. This latter interesting fact, which has been vaguely announced several times during the past thirty years, is set forth in a very clear light in a remarkable series of observations made by James Graves at Valencia, Ireland, on the spontaneous currents observed in the Atlantic cables in 1871. Indefinite ideas also prevail among telegraphers to the effect that the approach of storms is frequently heralded by special earth currents. The importance of having regular observations, at different places, of natural earth currents is more and more frequently insisted upon, and to a certain extent an attempt has been made to do this in India. Every one of the regular tests of the government telegraph lines in that country is made with positive and negative currents, and from the different values is obtained the electro-motive force of the natural line current in terms of that of a single Daniell's cell. These determinations are as regularly made as are the tests for conduction and insulation of the lines. The powerful earth currents that occur during heavy thunder-storms cause trouble similar to that produced by the earth currents of the aurora. On the approach of thunder-storms, the French Atlantic cable often gave indications several days in advance; coming first in a series of slight galvanic shocks, increasing as the storm came onward to the coast, when they were very strong. As to the origin of these currents, Mr. Varley advanced the idea that they are due to the rotation of the earth, which, according to well-known principles, should produce an electric current passing through the solid earth from west to east. The variations of intensity of the horizontal magnetic force are due to the variations of the currents of electricity passing through the earth.—*Jour. Soc. Tel. Eng.*, II., 80–120.

THE FUNCTION OF THE ARMATURES IN MAGNETS.

Jamin has recently established the following propositions:

1. The number of elementary magnetic threads, and, consequently, the quantity of magnetism which can be contained in a magnet, does not depend upon the average section.

2. The expansion (?) of the poles of these magnetic threads, or the distribution of their intensities, is regulated by the form and extent of the exterior surfaces of the magnet.

3. If these surfaces diminish, the tension augments up to the point when they become insufficient to allow the elementary poles to expand, and a portion of two contrary magnetisms disappears in order to reproduce the natural state.

4. If the surfaces change, but the mean sections remain constant, the quantity of magnetism remains constant, although its distribution may have varied very considerably with the change in the surface. If the surface remain constant, but the sections vary, the quantities of magnetism are proportional thereto. If the surface is not great enough, the total magnetism, which increases with the area of the section of the magnet, will be unable to expand itself over the bar, and must diminish itself; thus establishing the limit beyond which it is not possible to magnetize a given bar of iron.

On the other hand, if the mean section of the magnet diminish indefinitely, the tension of the magnetism will not increase indefinitely, but will cease to increase at a given limit fixed by the relation between the mean section and the surface of the bar. Having established the fact that the mean section determines the quantity of the magnetism, and that the surface of the magnet is that which regulates the distribution, it becomes evident that by a proper arrangement of the surface the latter may be saturated; that it is, in fact, the saturation of the surface which determines the saturation of the magnet. If, then, the magnet is made greater without increasing the quantity of magnetism, the tension of the latter becomes feebler; if it is made smaller, a portion of the magnetism is lost, but if, in this case, we add to the poles a piece of unmagnetized iron, we afford the space needed for the retention of the magnetism, and thus retain the strength of the magnet: this latter conclusion is well verified by direct experiment, and explains a portion of the action of armatures.—6 *C*, LXXVIII., 1500.

DIELECTRIC ABSORPTION.

Faraday, as is well known, discovered that a condenser takes on a decidedly greater quantity of electricity when one of the plates is charged with electricity while the other is connected with the earth. The quotient of the quantity of electricity which the isolated plate assumes when the separating non-conductor is air, and when the non-conductor is

some other substance, is called the specific inductive capacity, or, more briefly, the dielectric constant of the insulating substance. The condition in which the isolating body is found is called dielectric polarization, and the phenomena of dielectric polarization are quite distinct from those of electric conduction. Bolltzman has undertaken an extensive series of experimental investigations to show that the phenomenon known as dielectric action, at a distance, actually exists, and he has determined its amount. To this end, he fastened spheres made of different isolating substances to one of the arms of a very delicate balance, and measured the traction experienced by it for an electric metal sphere brought in the neighborhood. The minute interval of time occupied in order to produce the maximum effect showed that the traction results from a momentary dielectric polarization of the molecules.—*Sitz.-Ber. Roy. Acad. Sc., Vienna*, LXVIII, 81.

OPTICAL PROPERTIES OF THIN METALLIC FILMS.

In our previous volume are given the curious and valuable results obtained by Mascart on the phenomena of the polarization of light reflected from extremely thin films of silver and other metallic substances. The thickness of these films varied between one hundredth part of the length of a wave of light and the relatively much greater thickness of about one one thousandth of an inch. The observations of Mascart have been recently repeated by Quincke, who has made a very thorough study of the question of the prime angle of incidence for the different Fraunhofer lines. By this angle is understood one such that polarized light, after reflection from a plane surface, will be resolved into two components which are polarized, respectively perpendicular and parallel to the plane of incidence, and having a difference of phase of a quarter-wave length. Quincke finds that variations of temperature and of pressure in polishing frequently alter the optical qualities of a mirror very considerably; so that it is probably much more difficult to obtain faultless reflecting surfaces than transparent substances free from veins. He finds that, with the exception of gold, in the case of the metals observed by him, the prime angle of incidence, or polarization angle, diminishes with the diminution of the wave length, the reverse of what takes place with transparent

bodies. The diminution, however, is very different with the different metals. In reference to the prime angles for transparent laminæ of gold, platinum, and silver, he states that they show an increase with the increase of the thickness of the metal, but a different degree of increase for different colors. The value of this angle was not altered by magnetizing or electrizing the metallic mirrors. The effect of pressure, or of the relative distance among themselves of the particles of silver upon the angle of incidence, was most strikingly exhibited with silver collodion films. These were obtained by the process used in photography, the collodion film adhering firmly to a plate of glass. This film contains, uniformly distributed, finely divided particles of silver. It is opaque, even when very thin. If by a slight compression the silver particles are brought nearer each other, the prime angle of incidence varies considerably more than in the case of a layer of pure silver particles on glass. This dependence of the optical properties of a quantity of more or less transparent and non-transparent particles, on the relative distance of the latter, seems to him hardly compatible with the assumption that absorption and dispersion of light are determined solely by a mutual vibration of the molecules of the body, induced by the vibration of the molecules of the ether.—*Lond., Edin., and Dub. Phil. Mag.*, XLVII., 321.

ON THE FLIGHT OF BIRDS.

By ingenious and precise experiments on the locomotion of quadrupeds, birds, and insects, Marey has, during the past ten years, created a new province of experimental physiology. During this year he has elucidated one of the most abstruse points in the mechanical theory of flight. He has discovered the manner in which the air reacts on the wings of the flying bird, and sustains the bird during its flight. The steps by which he reached this beautiful discovery are interesting, and we will rapidly narrate them. He constructed an artificial bird, the proportion of whose parts and whose moving force he had founded on data obtained from experiments on flying birds. But when he tried his artificial bird, he was surprised to find that in order for it to rise on the wing he would be obliged to make its wings move with from three to four times the velocity they really had. But

it is evident that, with equal moving force, the resistance opposed to flight regulates the velocity of the wings; and, since the resistance varies as the square of the velocity, he had to admit that the air resisted from nine to sixteen times less with his artificial bird than it did in the case of the actual flying bird. In this dilemma he began to ponder on the reactions which the wing experienced during one of its blows upon the air. To obtain a correct idea of this action, he took a light disk and gave it a uniform motion in a direction perpendicular to its plane, and, by means of a dynamometer placed behind the disk, he noted the resistance of the air at different instants during this motion. He thus found, 1st, a considerable resistance at the beginning of the motion: this is the effect of the inertia of the column of air which the disk begins to displace; 2d, a more feeble pressure, which remains constant during the motion; and, 3d, a tendency to carry forward the disk when the latter is stopped. This action on the disk is due to the velocity acquired by the column of air already set in motion by the disk. Hence it is evident that if the bird's wing is always in that condition *when it is beginning to move a column of air*, it will meet with the greatest resistance; or, in other words, the wings will have the firmest support to act against. Now this is really the condition of the wings during a bird's flight; for, by reason of the translation of the bird, the wing, at each instant of its descent, acts on a new column of air, which it tends to depress; but, on account of the short duration of the pressure which it receives, any one of these columns has not the time to acquire the velocity of the wing. These columns are, therefore, successively *compressed*, and offer the maximum, or initial resistance to the wing.

But Marey, as is his custom, was not satisfied with this reasonable explanation alone; he also actually showed its truth by precise and conclusive experiments. He constructed an artificial bird, whose wings were set in perfectly regular motion by an air-pump worked in a uniform manner by a small steam-engine. This artificial bird was attached to a long horizontal arm, which revolved around a vertical pivot, so that the wings could beat when the bird was at rest and when it was carried round at the end of the arm. Now Marey observed that when the bird was at rest its wings beat

through an angle of about 60°; but when the arm was revolved, so that the bird was translated about ten meters per second, he observed that the amplitude of the beats of the wings was reduced to 30°, and even to 20°. This influence of the horizontal motion of the bird on the resistance opposed to the beats of its wings explains how the *point d'appui* is obtained during flight, and accounts for the following facts of observation and experiment:

1. When a bird rises, and begins its flight, the amplitude of the motion of its wings is very extended; but this amplitude is greatly reduced when the horizontal transport of the bird has become rapid.

2. When a flying bird is attached to a string, it falls, notwithstanding the beating of its wings, when the tension of the string stops the bird's horizontal motion.

3. A bird when rising in flight always, as nearly as possible, faces the wind. This is because, in this circumstance, the wind carries continually fresh layers of air under its wings, and places the bird in the same conditions as exist during its horizontal translation.

4. When a living bird is suspended at the end of the horizontal arm, so that he can freely use his wings and fly round in a circumference, if we now give to the arm a rapid motion of rotation, the motion of the wings of the bird are reduced to extreme slowness. The flap of the wing of a pigeon may thus be reduced to one second in duration, whereas the bird in flying freely makes eight flaps per second. As all motion is retarded by the resistances opposed to it, this experiment is one of the best proofs that one can bring forward of the increase of the resistance of the air from the velocity of the bird's translation.

This explanation of the increase of resistance caused by the motion of the bird was original with Marey, but it appears that M. M. Planavergne, of Marseilles, published in 1872 a similar explanation; but certainly to Marey belongs the credit of showing experimentally that this is not only a true cause, but a sufficient one.—*Comptes Rendus, January* 12, 26, *and February* 16, 1874.

THE DISCHARGE OF ELECTRIFIED CONDUCTORS.

Helmholtz, after explaining certain phenomena observed by Riess, states that their explanation is easy to understand, provided the discharge of a battery be not represented as a simple movement of electricity in one direction, but as a series of oscillations between the two coatings—oscillations which become less and less continually until the *vis viva* is extinguished by the sum of the resistance. But Montier, by a critical comparison of the works of Helmholtz and Clausius, shows that the discharge may be equally well represented by a movement of the electricity directed from one coating toward the other.—*Lond., Edin., and Dub. Phil. Mag.*, XLVII., 157.

THE IMPERMEABILITY OF A NON-HOMOGENEOUS ATMOSPHERE TO SONOROUS VIBRATIONS.

Professor Tyndall has experimentally shown that sound can not be transmitted through a column of gas of alternate dense and rarefied layers, formed by allowing sheets of coal gas to ascend between descending currents of carbonic gas. He sounded a bell at one end of a long box containing these columns of gas, and observed that a sensitive flame placed at the other end of the box remained motionless; but if the gases were replaced by air, or any gas of uniform density, the flame was depressed at each tap on the bell. The same effects were obtained when the box contained vertical columns of hot and cold air.—*Proc. Roy. Soc., February*, 1874.

ON THE REFLECTION OF SOUND FROM FLAMES AND HEATED GASES.

In the following experiments, Professor A. M. Mayer has shown in a simple and striking manner the reflection of sound by sheets of flame and heated gases, and has even obtained approximate measures of these reflecting powers: Take two similar resonators, and place the planes of their mouths at a right angle; then in this angle firmly fix the tuning-fork corresponding to the resonators, so that the broad face of one of its prongs faces the mouth of one resonator, while the space between the prongs faces the mouth of the other resonator. By trial, these two planes of the fork are placed at

such distances from the resonators that complete interference of the vibrations issuing from their mouths is obtained, and the only sound that reaches the ear is the faint sound given by the fork's action on the air outside the angle included by the mouths of the resonators. If, in these circumstances, we close the mouth of either resonator with a piece of card-board, the open resonator will strongly reinforce the sound of the fork. If we now also cover the mouth of the latter resonator with a piece of card-board, we shall again have silence. Also, if we substitute for one of the pieces of card-board a slip of stout glazed note-paper, the same result is obtained. But if we replace the piece of note-paper by a similar piece of French tracing-paper, a faint sound issues from the resonator so covered, because the tracing-paper is sufficiently permeable to sonorous vibrations to permit the resonator to reinforce the sound of the fork. This reinforcement becomes greater if we substitute for the tracing-paper a piece of tissue-paper, such as is used in printed books to cover steel engravings; and a yet greater reinforcement is produced when we put in the place of the tissue-paper a piece of the soft, loosely woven paper which is used by French instrument-makers for the inner wrapping of their packed wares. Professor Mayer thus obtained a graded series of substances more and more permeable to sonorous vibrations.

Again, when both resonators with their mouths uncovered produced interference, he screened the mouth of one of them with a bat's-wing coal-gas flame. The vibrations issuing from the resonators were no longer neutralized, but the vibrations from the uncovered resonator had a great ascendency over the other, so that a strong sound issued from it. Now if we can shield the mouth of the open resonator so that silence is exactly produced, we will have screened both resonators with substances equally reflecting and equally permeable to sound. On using his graded series of screens, Professor Mayer found that the tracing-paper just equaled in its reflecting power the gas flame. On lowering the position of the gas flame, so that its top luminous border was just below the mouth of the resonator—and therefore only a sheet of heated air ascended between the latter and the fork—the balance of the tracing-paper against the hot gases and vapor remained unimpaired.

Professor Mayer has in the above manner also shown the reflecting power of cold coal gas, of cold hydrogen, and carbonic-acid gas.—*Amer. Jour. of Science, November*, 1874.

ON THE ATMOSPHERE AS A VEHICLE OF SOUND.

Professor Tyndall, in a paper with the above title, has given to the Royal Society the results of his experiments on the transmission of the sounds of fog-horns and cannon through the atmosphere. To show Tyndall's results, and the conclusions he arrived at to explain them, we can not do better than quote the following passages from his paper:

"Thus far the investigation proceeded with hardly a gleam of a principle to connect the inconsistent results. The distance reached by the sound on the 19th of May was 3½ miles; on the 20th it was 5½ miles; and on the 2d of June 6 miles; on the 3d more than 9 miles; on the 10th it was also 9 miles; on the 25th it fell to 6½ miles; on the 26th it rose again to more than 9½ miles; on the 1st of July, as we have just seen, it reached 12¾ miles, whereas on the 2d the range shrunk to 4 miles. None of the meteorological agents observed could be singled out as the cause of the fluctuations. The wind exerts an acknowledged power over sound, but it could not account for these phenomena. On the 25th of June, for example, when the range was only 6½ miles, the wind was favorable; on the 26th, when the range exceeded 9½ miles, it was opposed to the sound. Nor could the varying optical clearness of the atmosphere be invoked as an explanation; for on July 1, when the range was 12¾ miles, a thick haze hid the white cliffs of the Foreland, while on many other days, when the acoustic range was not half so great, the atmosphere was optically clear. Up to July 3d all remained enigmatical; but on this date observations were made which seemed to me to displace surmise and perplexity by the clearer light of physical demonstration.

"On July 3d we first steamed to a point 2.9 miles southwest by west of the signal-station. No sounds, not even the guns, were heard at this distance. At 2 miles they were equally inaudible. But this being the position in which the sounds, though strong in the axis, invariably subsided, we steamed to the exact bearing from which our observations had been made upon July 1. At 12:15 P.M., and at a dis-

tance of $3\frac{3}{4}$ miles from the station, *with a calm air and a smooth sea*, the horns and whistle (American) were sounded, but they were inaudible. Surprised at this result, I signaled for the guns. They were all fired, but, though the smoke seemed at hand, no sound whatever reached us. On July 1, in this bearing, the observed range of both horns and guns was $10\frac{1}{2}$ miles, while on the bearing of the Varne light-vessel it was nearly 13 miles. We steamed in to 3 miles, paused, and listened with all attention; but neither horn nor whistle was heard. The guns were again signaled for; five of them were fired in succession, but not one of them was heard. We steamed in on the same bearing to 2 miles, and had the guns fired point-blank at us. The howitzer and the mortar, with 3-pound charges, yielded a feeble thud, while the 18-pounder was wholly unheard. Applying the law of inverse squares, it follows that, with air and sea, according to accepted notions, in far worse condition, the sound at 2 miles' distance on July 1 must have had more than forty times the intensity which it possessed at the same distance at 3 P.M. on the 3d. . . .

"Humboldt, in his observations on the Falls of the Orinoco, is known to have applied these principles to sound. He found the noise of the falls far louder by night than by day, though in that region the night is far noisier than the day. The plain between him and the falls consisted of spaces of grass and rocks intermingled. In the heat of the day he found the temperature of the rock to be considerably higher than that of the grass. On every heated rock, he concluded, rose a column of air rarefied by the heat; and he ascribed the deadening of the sound to the reflections which it endured at the limiting surfaces of the rarer and denser air. This philosophical explanation, which admits of experimental illustration in the laboratory, made it generally known that a non-homogeneous atmosphere is unfavorable to the transmission of sound.

"But what on July 3, not with the variously heated plain of Antures, but with a calm sea as a basis for the atmosphere, could so destroy its homogeneity as to enable it to quench in so short a distance so vast a body of sound? I here submit to the judgment of scientific men my own course of thought regarding this question. As I stood upon the deck

of the *Irene* pondering it, I became conscious of the exceeding power of the sun beating against my back and heating the objects near me. Beams of equal power were falling on the sea, and must have produced copious evaporation. That the vapor generated should so rise and mingle with the air as to form an absolutely homogeneous medium I considered in the highest degree improbable. It would be sure, I thought, to rise in streams, breaking through the superincumbent air now at one point, now at another, thus rendering the air *flocculent* with wreaths and striæ, charged in different degrees with the buoyant vapor. At the limiting surfaces of these spaces, though invisible, we should have the conditions necessary to the production of partial echoes and the consequent waste of sound." This hypothesis Tyndall subsequently tested. He found that the shielding influence of a cloud, which cast a shadow from the fog-horn to the vessel, caused an increase in the intensity of the sound. He also observed that falling rain and fog, by rendering the air of homogeneous density, produced the same effect. He then proceeds to say: "But both the argument and the phenomena have a complementary side, which we have now to consider. A stratum of air less than three miles thick on a calm day has been proved competent to stifle both the cannonade and the horn-sounds employed at the South Foreland; while, according to the foregoing explanation, this result was due to the irregular admixture of air and aqueous vapor, which filled the atmosphere with an impervious *acoustic cloud* on a day of perfect *optical* transparency. But, granting this, it is incredible that so great a body of sound could utterly disappear in so short a distance without rendering any account of itself. Supposing, then, instead of placing ourselves behind the acoustic cloud, we were to place ourselves in front of it, might we not, in accordance with the law of conservation, expect to receive by reflection the sound which had failed to reach us by transmission? The case would then be strictly analogous to the reflection of light from an ordinary cloud to an observer placed between it and the sun.

"My first care in the early part of the day in question was to assure myself that our inability to hear the sound did not arise from any derangement of the instruments on shore. Accompanied by Mr. Edwards, who was good enough on this

and some other days to act as my amanuensis, at 1 P.M. I was rowed to the shore, and landed at the base of the South Foreland Cliff. The body of air which had already shown such extraordinary power to intercept the sound, and which manifested this power still more impressively later in the day, was now in front of us. On it the sonorous waves impinged, and from it they were sent back to us with astonishing intensity. The instruments, hidden from view, were on the summit of a cliff two hundred and thirty-five feet above us, the sea was smooth and clear of ships, the atmosphere was without a cloud, and there was no object in sight which could possibly produce the observed effect. From the perfectly transparent air the echoes came, at first with a strength apparently but little less than that of the direct sound, and then dying gradually and continuously away. A remark made by my talented companion in his note-book at the time shows how the phenomenon affected him—'Beyond saying that the echoes seemed to come from the expanse of ocean, it did not appear possible to indicate any more definite point of reflection.' Indeed, no such point was to be seen; the echoes reached us as if by magic, from absolutely invisible walls.

"Here, in my opinion, we have the key to many of the mysteries and discrepancies of evidence which beset this question. The foregoing observations show that there is no need to doubt either the veracity or capability of the conflicting witnesses, for the variations of the atmosphere are more than sufficient to account for theirs. The mistake, indeed, hitherto has been, not in reporting incorrectly, but in neglecting the monotonous operation of repeating the observations during a sufficient time."

The above explanation given by Tyndall has not been generally received by men of science. Certainly his experiments were not sufficiently extended and varied to enable one to form a conclusive opinion. M. Baudrimont, in the *Comptes Rendus* for April, 1874, calls attention to the improbability of the existence of vertical columns or walls of dense and rarefied air existing over the sea on a calm day. He is of opinion that there would exist horizontal layers of air, gradually increasing in density as we ascended; and as sound progresses more rapidly in warm and moist air than in dry

and cold air, he sees a true and sufficient cause of the phenomena described by Tyndall in the deadening of the sound, caused by a deformation of its wave-front in consequence of the different velocities existing in the various directions of the sonorous impulses.

In the two following abstracts it will be seen that both Professor Henry, who has had a long experience with such phenomena on our own coast, and Professor Reynolds in England, do not agree with Professor Tyndall, but attribute the apparent impermeability of the air to sound observed by Tyndall to the tilting of the sonorous wave-front, caused by the difference of the velocities with which the air moves at the ground, or on the surface of the sea, and at an elevation.

EFFECT OF WIND ON SOUND-WAVES.

Professor Henry presented a series of observations on this subject at the meeting of the National Academy of Sciences, in New York and Washington, but since then he had made many additional observations, and Professor Tyndall had also been investigating the same matter. It is in accordance with the most extended observations, and with the experience of all who have given attention to the subject of the propagation of sound, that the audibility of it is much influenced by the wind, and that as a general rule, to which there are some exceptions, sound is heard more distinctly when propagated in the direction of the wind than when in opposition to it. There are some well-authenticated cases, however, in which sound has been heard at a greater distance against the wind than with it. The effect of the wind on sound is by no means a simple phenomenon of ready explanation. At first sight it might appear that the sound was carried onward with the wind when the two were coincident in direction, and that it was retarded when in an opposite direction; but this explanation is not sufficient to account for the phenomenon when we consider the fact that sound moves at the rate of upward of seven hundred miles an hour, while a wind of seven miles an hour is sufficient to give a penetrating power to a given sound of double the intensity, whereas from the foregoing consideration it should have an effect of only one per cent. The only explanation which has been offered for the phenomena is that in a river of air of considerable depth

moving over the surface of the earth, the lower part moves with less velocity on account of friction than the upper part, and that consequently the tendency would be to tilt the sound-wave so as to throw the sound downward toward the earth in the case of the sound moving in the same direction as the wind, and to deflect it upward in case the movement is in an opposite direction, throwing it into the air above the head of the observer. This hypothesis gives a ready explanation of all the phenomena observed, and was fully illustrated by a series of experiments made by Professor Henry in the vicinity of the light-ship off Sandy Hook last summer. Two steamers were supplied with whistles producing the same tone, and sent, one to the westward and one to the eastward. A wind was blowing from the west at the time with a velocity of six and a half miles an hour. The whistle on one steamer was heard until it sailed a mile from the light-ship on which the observers were stationed, while the sound of the other, which was carried by the wind, was heard two and a half miles. This was in accordance with the general experience of the effect of wind in accelerating the sound-waves. At noon, however, the experiment was repeated in a dead calm, and the same effect was observed, the sound from the steamer that sailed eastward being heard two and a half times as far as the sound from the other steamer. Again in the afternoon the experiment was tried after the wind had chopped about and was blowing from the east, but the observers were surprised to find no change in the result. Apparently the course of the wind had no effect upon the velocity of the sound. Professor Henry was satisfied, however, that the variation in the wind occurred only at the earth's surface, and that a river of wind was flowing steadily from the west all the time. Next day he repeated the experiments under exactly similar conditions, the wind falling to a calm, and then shifting as before. He sent up small balloons at the same time, and found the idea to be correct. A steady current from the west prevailed all the time. By this beautiful experiment the truth of his theory as to the uniform effect of wind on sound was completely demonstrated.

Professor Tyndall, in trying to account for the variable rate of the transmission of sound, and the apparently contradictory effect at times of the wind's action, refers the

phenomena to a flocculent condition of the atmosphere, produced by the mingling of air and vapor, and by patches of air of different temperature. Professor Henry said that fog has been shown to have no apparent effect on the penetrating power of sound. A sound has been heard twenty-five miles through a dense fog. Snow-storms have no effect. Vapor in the air could not, therefore, produce the phenomena, as Tyndall supposes. The fault with Tyndall's experiments were that they were all made in one direction, and from these partial experiments he derived his theory of the acoustic opacity of the atmosphere. Last summer Professor Henry placed a large steam-trumpet on a steamer. The wind was from the west, and the trumpet was pointed northward. The steamer sailed toward the wind, and carried the sound only three and a half miles, but in sailing in a contrary direction the sound was heard for a distance of eight miles. If Professor Tyndall had observed the sound from one direction only, he would have called the day opaque; if from the other only, he would have concluded it was quite clear.—*N. Y. Tribune.*

ON THE REFRACTION OF SOUND BY THE ATMOSPHERE.

The above is the title of a very interesting paper, read before the Royal Society April 23, 1874, by Professor Osborne Reynolds. The principal object of this paper is to show that sound is refracted upward in the atmosphere in direct proportion to the upward diminution of the temperature, and hence to explain several phenomena of sound, and particularly the results of Professor Tyndall's recent observations off the South Foreland.

The paper commences by describing the explanation of the effect of wind upon sound, viz., that this effect is due to the lifting of the sound from the ground, and not to its destruction, as is generally supposed. The lifting of the sound is shown to be due to the different velocities with which the air moves at the ground and at an elevation above it. During a wind the air moves faster above than below, therefore sound moving against the wind moves faster below than above, the effect of which is to refract or turn the sound upward; so that the "rays" of sound, which would otherwise move horizontally along the ground, actually move upward in circular or more nearly hyperbolic paths, and thus, if there

is sufficient distance, pass over the observer's head. This explanation was propounded by Professor Stokes in 1857, but was discovered independently by the author.

The paper then contains the description of experiments made with a view to establish this explanation, and from which it appears that:

1. The velocity of wind over grass differs by one half at elevations of one and eight feet, and by somewhat less over snow.

2. When there is no wind, sound proceeding over a rough surface is destroyed at the surface, and is thus less intense below than above.

3. That sounds proceeding against the wind are lifted up off the ground, and hence the range is diminished at low elevations; but that the sound is not destroyed, and may be heard from positions sufficiently elevated with even greater distinctness than at the same distances with the wind.

4. That sounds proceeding with the wind are brought down to the ground in such a manner as to counterbalance the effect of the rough surface (2); and hence, contrary to the experiments of Delaroche, the range at the ground is greater with the wind than at right angles to its direction, or where there is no wind.

On one occasion it was found that the sound could be heard three hundred and sixty yards with the wind at all elevations, whereas it could be heard only two hundred yards at right angles to the wind standing up; and, against the wind, it was lost at thirty yards at the ground, seventy yards standing up, and at one hundred and sixty yards at an elevation of thirty feet, although it could be heard distinctly at this latter point a few feet higher.

As might be expected, the effect of raising the bell was to extend its range to windward, to even a greater extent than was obtained by an equal elevation of the observer.

These results agree so well with what might be expected from the theory, as to place its truth and completeness beyond question.

It is thus argued that, since the wind raises the sound so that it can not be heard at the ground, by causing it to move faster below than above, any other cause which produces such a difference in velocity will lift the sound in the same way; and therefore that an upward diminution in the tem-

perature of the air must produce this effect; for every degree of temperature between 32° and 70° adds nearly one foot per second to the velocity of sound. Mr. Glaisher's balloon observations show that when the sun is shining with a clear sky the variation from the surface is 1° Fahr. for every hundred feet, and that with a cloudy sky 0.5°, or half what it is with a clear sky. Hence it is shown that "rays" of sound, otherwise horizontal, will be refracted upward in the form of circles, the radii of which are 110,000 feet with a clear sky and 220,000 with a cloudy sky—that is to say, the refraction on bright, hot days will be double what it is on dull days, and still more under exceptional circumstances, and comparing day with night.

It is then shown by calculation that the greatest refraction (110,000 radius) is sufficient to render sound from a cliff 235 feet high inaudible on the deck of a ship at one and three fourths of a mile, except such sound as might reach the observer by divergence from the waves passing over his head; whereas when the refraction is least (220,000 radius)—that is, when the sky is cloudy—the range would be extended to two and a half miles, with a similar extension for the diverging waves, and under exceptional circumstances the extension would be much greater. It is hence inferred that the phenomenon which Professor Tyndall observed on the 3d of July and other days (namely, that when the air was still and the sun was hot he could not hear guns and other sounds from the cliffs, 235 feet high, more than two miles, whereas when the sky was clouded the range of the sounds was extended to three miles, and, as evening approached, much farther) was due, not to the stoppage or reflection of the sound by clouds of invisible vapor, as Professor Tyndall has supposed, but to the sounds being lifted over his head by refraction in the manner described; and that, had he been able to ascend thirty feet up the mast, he might at any time have extended the range of the sounds by a quarter of a mile at least.

THE MECHANICAL EQUIVALENT OF SOUND.

In paper No. 7 of his "Researches in Acoustics," Professor Mayer gives an experimental research on the determination of the mechanical equivalent of a given sound.

The author considers his result as only approximative, yet it is interesting as the first determination of this kind ever made, and valuable as conveying an idea of the amount of mechanical energy necessary to produce definite sonorous vibrations in the air. We can not do better than quote from Professor Mayer's paper:

"In the following manner I have recently made experiments in the direction of determining the equivalent of a given sonorous aerial vibration in a fraction of a Joule's unit of 772 foot-pounds. I stretched between the prongs of a Ut_3 tuning-fork a piece of sheet caoutchouc, $\frac{1}{100}$ of an inch in thickness, and about half an inch broad. The effect of this rubber on the vibrating fork is rapidly to extinguish its vibrations, while the rubber itself is heated; and if a fork be vibrated continuously by one and the same force when the rubber is stretched on it, and then when it is taken off, the aerial vibrations produced by the fork are far more intense in the latter circumstances than in the former. By a method described by me in the *American Journal of Science*, February, 1871, I measured the relative intensities of the aerial vibrations on these two conditions of their production. The sheet of caoutchouc was inclosed in a compound thermo-battery, and the fork vibrated during a known interval; the rubber was heated by the vibrations, which would have appeared as sonorous vibrations if the rubber had been removed from the fork. The amount of heat given to the caoutchouc was accurately determined by observing the deflections of a Thomson's reflecting-galvanometer connected with the thermo-battery; and by knowing the time during which the fork vibrated, the amount of heat given to the caoutchouc during this time, and the equivalent of the heated rubber in heated water, I calculated the intensity of the sonorous vibrations in terms of a thermal unit, from which I at once obtained the value of the sonorous aerial vibrations when the fork was not heating the rubber; in other words, when it vibrated freely. I thus found that the sonorous aerial vibrations produced during ten seconds by a Ut_3 fork placed in front of its resonator equaled about $\frac{1}{100,000}$ of a Joule's unit; that is, these aerial vibrations can be expressed in the work done in lifting 54 grains one foot high. This quantity of heat is equal to the heating of one pound of water $\frac{1}{100,000}$ of a de-

gree Fahrenheit."—*American Journal of Science, November,* 1874.

ON AN OPTICAL METHOD OF STUDYING THE VIBRATIONS OF SOLID BODIES.

Professor O. N. Rood has devised a very simple and precise method of ascertaining the number of vibrations of solid bodies, such as cords, rods, plates, bells, and membranes. He takes a fork whose number of vibrations per second is accurately known, and attaches to one of its prongs a short piece of very fine wire. Another piece of wire is attached to the body whose number of vibrations are to be compared with the fork, and these two wires are brought near each other with their lengths crossed. When the fork and the body are now vibrated, the wires will vibrate in planes at right angles to each other, and the intersections of the vibrating wires, when viewed with a small telescope against a bright background, will give an optical figure; for, from the persistence of impressions on the retina, the wires give a shaded figure where, in their vibrations, they overlap. Thus each musical interval, formed in the number of vibrations of the two bodies, will give its own distinctive figure. From the foregoing it evidently is easy with this method to bring a vibrating string into unison with a given tuning-fork, or to adjust it so that the interval shall be a quint, octave, twelfth, or double octave, above or below. It is also easy to ascertain the number of vibrations made by a string in a given case, by the aid of a bridge and a properly selected fork making a known number of vibrations, the string being shortened by the bridge until it furnishes one of the above-mentioned figures, and hence executes a known number of vibrations; after which the number of vibrations made by its whole length can readily be calculated from the law that the numbers of vibrations of similar strings are inversely as their lengths.

After a string has, as above, been brought to make a known number of vibrations per second, it may be used instead of the standard fork; and by placing this string athwart a wire attached to any other solid body, we can alter the length of the string until they form unison, or a known interval with each other; and then, on measuring the length of the string

required to bring about this result, we can readily calculate the number of vibrations per second of the solid. Professor Rood has given the results of this method in determinations of the vibrations of cords, rods, bars, plates, bells, and membranes, and finds that he can determine to from one to two tenths of a vibration the number of vibrations per second of these bodies.

ON THE MODE OF HEARING IN MAN AND MAMMALS.

Professor Alfred M. Mayer, from calculations on the effects of the form of the cochlea of the inner ear on the sonorous vibrations which enter it, arrived at the conclusion that the terminal fibrils of the auditory nerve vibrate, in a given time, only half as frequently as the membrane of the drum of the ear. The auditory nerve fibrils are attached to the middle points of about 18,000 minute elastic rods or cords, stretched between the basilar membrane of the ductus of the cochlea and what is known as the *lamina reticularis*. Professor Mayer is of the opinion that these cords and their attached nerve fibrils do not receive their vibrations from sonorous pulses sent directly into the ductus, but are set in vibration by tremors imparted to them from the basilar membrane. The basilar membrane itself is vibrated by the pulses sent into the ductus from the membrane of the drum of the ear, through the intervention of the chain of minute ear-bones. Hence any one of these stretched cords must vibrate half as often in a second as does the basilar membrane, or the membrane of the tympanum. Now it is a fact easily proved experimentally that a stretched cord, attached to a vibrating membrane, must make, in the same time, half as many vibrations as the membrane.

Professor Mayer has illustrated his view of the manner in which we hear by the following experiment: A loosely stretched membrane, placed near a sounding reed-pipe, stands for the basilar membrane; stretched strings of various lengths and diameters, and loaded at their centres, are attached to the membrane, and stand for the minute tuned cords of the ductus. On sounding the reed-pipe, only those strings in tune with the harmonics existing in the composite sound of the reed will enter into vibration; similarly, when the same sound-vibrations enter the inner ear, and vibrate the bas-

ilar membrane, the only cords in the ductus which enter into vibration are those in tune with the elementary vibrations existing in the membrane. Also, it is to be observed that as the loaded string makes only one vibration to two of the membrane, so the cord in the ear makes only one vibration to two of the basilar membrane, or of the membrane of the drum of the ear.

Reaching this curious inference, Professor Mayer, in order to bring his supposition to a rigid experimental test, reasoned in the following manner: If it be true that when simple vibrations impinge on the ear the tympanic and basilar membranes vibrate twice while the stretched cord in the ear vibrates only once, then it follows that if we hold a vibrating tuning-fork near the ear, and clearly apprehend the character of its sound, we will have a sensation which corresponds to that usually designated as the pitch of this fork; and this sensation does not contain in it a sound corresponding to the higher octave of the fork. In this experiment, according to Professor Mayer, the auditory nerve fibrils made half as many vibrations per second as did the prong of the fork and the tympanic membrane. But if the vibrations of this fork be sent directly into the inner ear through the bony parts of the temporal bone, by placing the foot of the fork on the zygomatic process, close to the ear, or on the mastoid bone behind the ear, we will, according to his hypothesis, vibrate the auditory nerve fibrils as often as the fork vibrates, and therefore, in this second experiment, the sound of the fork should rise one octave in pitch above what was perceived when the fork vibrated the air outside of the head. This experiment has been repeatedly tried by many persons, and it always gives the result predicted by Professor Mayer, as a necessary consequence of his reasoning on the mode of audition. Among others who have confirmed this remarkable deduction, is Madame Seiler (whose educated musical ear assisted Helmholtz in his delicate researches in physiological acoustics), who bears testimony to the above fact, first discovered by Professor Mayer.

Professor Mayer ends his paper on this subject as follows: "The fact that sound pulses sent into the inner ear through the head give the sensation corresponding to the higher octave of that perceived when the fork vibrates the air outside

the ear, and, therefore, that different co-vibrating parts of the ear are set in action by the vibrations reaching the ear by these two different routes, is a necessary consequence of my hypothesis of the mode of audition, and was not suspected until my hypothesis pointed it out to me; nor was it known until I attempted to test the hypothesis by experiment. I know of no other hypothesis which accounts for this fact, which, while it is a necessary consequence of my own views, is directly opposed to those hypotheses hitherto formed on the mode of audition; for, according to the latter, the co-vibrating parts of the ear make as many oscillations in a given interval as the tympanic and basilar membranes."—*Amer. Jour. Sci., August*, 1874.

ON THE VIBRATION OF LIQUID SURFACES.

M. Barthélemy has made a study of the undulations produced on liquid surfaces when these are set in vibration. His best results were obtained when the vessel containing the liquid was placed upon the resonant box of a vibrating tuning-fork. In these circumstances the liquid surface is formed of stationary elevations and depressions, the results of uniform vibration over its whole surface. The phenomena may be observed either directly by a small telescope, or, better, by projection upon a screen. For this purpose a beam of sunlight is reflected obliquely from the liquid, and, passing through a lens, the latter forms an image of the surface on a screen. This image is so steady that it may be photographed. In a rectangular vessel two sets of brilliant lines parallel to its sides are produced, and bright points are formed at the intersections of these lines. Barthélemy deduces the two following laws: 1. The breadth of the undulations is inversely as the number of vibrations. 2. The distance between two lines produced by the same fork is independent of the density of the liquid. In circular vessels the vibration figures consist of equidistant concentric circles intersected by equidistant radii. If the vessel is vibrated by the fork touching it, then a cross formed of quiescent liquid is produced: the lines of the cross cut the vessel at its nodal points. Triangular vessels give lines perpendicular to the sides, forming brilliant hexagons, the centres of which are the angles of fainter hexagons, having the radii of the first set for sides. As

the motion lessens, only one set of lines perish, and the surface is covered with rectilinear waves perpendicular to one of the bases. Elliptical vessels give figures of exceeding beauty, the lines having reference to the two axes of the ellipse. The author calls attention to the general character of these wave-surfaces. In the basin of a fountain, in the waves of the sea, these forms are recognized; even in the sand on the bottom of the sea they can be traced. Certain lines thus made gave on measurement 2.6 vibrations per second. They may be seen 100 meters from the beach, and at a depth of eight to ten meters. So, out of the water, the sand on the beach was found to have taken these forms; thus suggesting that the air itself was capable of similar vibration. So also clouds are arranged often in parallel bands, being then considered a precursor of fine weather. Even in geology, the author regards certain regular and equidistant foldings of rocks as evidence of analogous vibrations. The ventral segments of a liquid vein, M. Barthélemy thinks, are produced by the vibration of the liquid mass upon which it falls reacting upon it. And he makes an ingenious application of these facts to account for the phenomena of stratification produced by electric discharges in rarefied media.—*Ann. Chim. Phys.*, V., *January*, 1874; *Amer. Jour. Science, June*, 1874.

AIR-PRESSURE REQUIRED TO SOUND VARIOUS WIND INSTRUMENTS.

Dr. W. H. Stone has recently measured the air-pressure required to sound various wind instruments, by introducing into the mouth of the performer a small glass tube connected with a water-pressure gauge. He thus ascertained that when the musicians sounded "mezzo-forte" on the following instruments, air-pressures were produced in the gauge as given below opposite the respective instruments:

	LOWER NOTES. Inches.	HIGHEST NOTES. Inches.
Oboe	9	17
Clarionet	15	8
Bassoon	12	24
Horn	5	27
Cornet	10	34
Trumpet	12	33
Euphonium	8	40
Bombardon	3	36

It is seen from the above experiment that the pressures required to sound wind instruments are small, when it is known that Dr. Stone found that the musicians could support with their lips a pressure of six feet of water.—*Philosophical Magazine*, XLVIII., 114.

ON THE DURATIONS OF SONOROUS SENSATIONS.

Professor Mayer, in paper No. 6 of his series of "Researches in Acoustics," gives his discovery of the law connecting the pitch of a sound with the time during which its sensation remains in the ear after the vibrations causing this sound have ceased outside the ear. These after-sensations are called residual sensations. He finds that the residual sensation of the treble C, of 256 vibrations per second, lasts $\frac{1}{50}$ of a second; the lowest audible sound, produced by 40 vibrations per second, lasts in the ear $\frac{1}{10}$ of a second, while the highest audible sound, of 40,000 vibrations per second, endures only $\frac{1}{400}$ of a second.

The knowledge of the above law (which has for its expression the following formula, $D=\left(\frac{53,248}{N+23}+24\right).0001$, in which D is the duration of the residual sensation, and N is the number of vibrations per second of the sound corresponding to D) has shed much light on various obscure points in the physiology of audition. Among other results, it has explained why we do not have a continuous sonorous sensation from vibrations fewer than 40 per second; it has confirmed Helmholtz's views of the high differentiation of the functions of the sensory apparatus of the ear; it has rendered quantitative much of Helmholtz's work on the physiological theory of music; and has led to the curious discovery that a composite sound can be analyzed into its elementary simple sounds, or harmonics, by means of a perforated rotating disk. Thus, if a large disk, with sectors cut out of it, is rapidly revolved between the ear and a reed-pipe (which always gives a highly composite sound), we shall have the composite sound reaching the ear in a series of impacts, which succeed each other so rapidly that even those of the highest harmonic of the reed blend into a continuous sensation; but on gradually lowering the velocity of rotation, the impacts of this highest harmonic can no longer blend, and we per-

ceive the harmonic beating on the ear alone. This fact can readily be confirmed by the aid of one of Helmholtz's resonators. A further slight lowering of the velocity of the disk brings out the beats of the next lower harmonic, and so on, until the velocity has been so diminished that even the beats of the lowest or fundamental harmonic are perceived; and then all of the component sounds are beating in unison; but yet the effects they produce on the ear are very different, for the higher harmonics, notwithstanding their feebler intensities, must be heard more distinctly, because their intermittences are furthest removed from the numbers that cause their sensations to blend.

The fact that the durations of the residual sensations diminish as the numbers of vibrations producing the sounds increase, leads to the knowledge of a new and curious phenomenon in the physiology of audition, viz., that the timbre, or quality, of a composite sound begins to change at the instant the vibrations outside the ear have ceased; for from that instant the residual sensation becomes more and more simple in its character, until at last only the simple sound of the fundamental harmonic remains in the ear, and soon after this sensation also vanishes. Thus, after the vibrations of a C reed-pipe, of 128 vibrations per second, containing twenty harmonics, have ceased, the residual sensation of the twentieth harmonic, or that highest in pitch, disappears in the $\frac{1}{327}$ of a second; but the sensation of the fundamental or lowest harmonic remains in the ear $\frac{1}{29}$ of a second after the sensation of the highest has vanished; and the fundamental remains $\frac{1}{58}$ of a second after the cessation of the sensation of the harmonic next above it.

ON THE CONNECTION EXISTING BETWEEN THE DIRECTION OF CLEAVAGE AND THE CONDUCTIVITY OF HEAT, AND EXPANSION BY HEAT, IN CRYSTALS AND LAMELLATED ROCKS.

M. Jannettaz has recently determined the following important laws of the propagation of heat in crystallized bodies:

1. If a crystal have a plane of cleavage, heat is propagated with greater facility in directions parallel to that plane than in directions perpendicular to it.

2. If a crystal cleave in several directions in planes perpendicular to each other, the greatest axis of thermal con-

ductivity is parallel to the intersections of the planes of most easy cleavage, and the smallest axis of conductivity is parallel to the intersection of the planes of most difficult cleavage.

3. If the planes of cleavage in the same crystal are oblique to each other, the greatest axis of thermal conductivity is the intersection of the angle which includes the mutual inclination of the planes of easiest cleavage, if both of these planes are equally easy of cleavage; and if they are unequally cleavable, then the greatest axis is at an angular distance from these planes, which varies in the same direction as the plane of easy cleavage.

Jannettaz also made experiments on fifteen species of schistose rocks, and invariably found that heat is conducted with equal facility in all directions in the planes of lamellation of these rocks, but in directions perpendicular to these planes; that is, in sections at right angles to the cleavage, heat is conducted easier in the direction of the cleavage than across the cleavage. In the case of a steatite from the United States, heat is conducted twice as well along the line of cleavage as across this direction.

Jannettaz used in his experiment the method of Sénarmont; that is, he coated the section of the mineral with wax, and leading through it a silver wire, whose farther end was heated, he determined the rate of conduction in the plate, outward from the wire, by observation of the isothermal contour determined by the melting of the wax.

In connection with the experiments of Jannettaz, it is interesting to know that Fizeau has recently found that schistose rocks dilate more in a direction perpendicular to their cleavage than in the direction of the cleavage. Also it has been determined by experiments of the International Metric Commission on a large ingot of platinum, containing ten per cent. of iridium, that the co-efficient of expansion of this bar was increased after having rendered it more dense by subjecting it to the action of a trip-hammer; its co-efficient, from this cause, rising from 0.00000886 to 0.00000902. It was found that after two annealings at a temperature of 1300° C., the co-efficient fell nearly to what it had been before the ingot was hammered. The rolling of metals produces the same effect on them as above described; but wire-drawing a metal reduces its co-efficient of expansion.

D. CHEMISTRY AND METALLURGY.

HYDROGENOUS PALLADIUM.

The combination of hydrogen with palladium, first discovered by Graham, and termed by him occlusion, has been generally supposed to indicate the formation of a true alloy between the metals palladium and hydrogenium. This opinion was stated by Graham, who proved that the density of palladium, when it conceals from eight to nine hundred volumes of hydrogen within itself, is sensibly inferior to that of the pure metal, while its tenacity and electric conductivity are diminished and the magnetism augmented. This subject has been lately investigated by Messrs. Troost and Hautefeuille, who have shown that the phenomenon is more complex than has hitherto been supposed; that in fact palladium forms with hydrogen a definite compound, whose formula is two molecules of the former and one of the latter. This combination itself, once formed, can then dissolve hydrogen gas after the manner of platinum, and in quantity variable with its physical state. This property of the new compound explains the difference between the numerical results obtained by Graham, according as he employed palladium wire or spongy palladium. This hydrogenous palladium, together with certain similar combinations of potassium and sodium with hydrogen, forms a series parallel to that combination of copper with hydrogen called by Wurtz the hydride of copper.

THE OCCLUSION OF HYDROGEN BY IRON.

At a recent meeting of the Philosophical Society of Manchester, England, Mr. Johnson exhibited some iron and steel wire whose nature had been so changed that, from being exceedingly tough, it had become short and brittle, while its weight was increased; and a fresh fracture at any point appeared, when treated chemically, to show that the chemical constitution of the iron had undergone a remarkable change. Professor Osborne Reynolds having made a careful examination of this wire, seems to have established the fact that free hydrogen had entered into and combined with the iron and

changed it—a point of the greatest importance in connection with the construction of ships and boilers, since if, as is probable, the saturation of iron with hydrogen takes place whenever oxidation goes on in water, then the iron of boilers and ships may at times be changed in character and rendered brittle, in the same manner as Mr. Johnson's wire.—12 *A*, 1874, IX., 396.

MANUFACTURE OF OXYGEN GAS.

In the manufacture of oxygen gas from chlorate of potash, J. Löwe recommends the use of freshly ignited ferric oxide (the variety once known as *caput mortuum*) instead of the black oxide of manganese. It should be very intimately mixed with the chlorate. There is said to be greater speed attained in the operation, while the danger of an explosion becomes less.—18 *C, March* 18, 1874.

IS HYDROGEN A METAL?

The discussion concerning the presumable metallic nature of hydrogen, which is periodically renewed, has received fresh impulse from some discoveries recently made by MM. Troost and Hautefeuille, who announce that hydrogen forms a definite chemical compound with two equivalents of either sodium or potassium. Potassium, when heated to 200°, will combine with hydrogen, but at 900° the compound is entirely destroyed. The newly discovered compounds present all the characteristics of amalgams—the metallic lustre and physical appearance of a metal. The authors therefore urge that these hydrides of sodium and potassium are true alloys, and consider their existence as a new proof that hydrogen is a metal. Another discovery of similar tenor, by the same investigators, is the fact that palladium forms with hydrogen a definite compound, with the formula Pd_2H; that this combination can dissolve hydrogen gas like platinum, and in variable quantity, according to its physical condition. This property of the palladium alloy, according to the authors, explains the want of uniformity of the numerical results obtained by Graham, the originator of this method of inquiry, according as he employed the palladium as wire or in the form of sponge.

EXPLOSION AND IGNITION BY PERMANGANATE OF POTASH AND SULPHURIC ACID.

According to a series of experiments by Böttger, a mixture of two parts of perfectly dry permanganate of potash with about two to three parts, by weight, of concentrated sulphuric acid, will frequently cause most violent explosions with, and subsequent ignition of, many substances, especially volatile oils, on contact with them at ordinary temperatures; as by placing ten to twelve drops of such an oil in a capsule, and stirring into it as much of the mixture as will adhere to the end of a heavy glass rod. Such explosions occur with oil of thyme, of mace, of cinnamon, of rue, of cubeb, of lemon, of marjoram, and of spike, and with rectified oil of turpentine. Simple ignition, without explosion, occurs with oil of rosemary, of lavender, of cloves, of rose, of geranium, of gaultheria, of caraway, of cajeput, and of bitter almonds, and with rectified petroleum, especially if a small quantity of the oil be dropped on bibulous paper, and then brought in contact with the mixture. At times, however, from unknown causes, explosions have also taken place with these, so that great care is necessary in experimenting with them. Alcohol, ether, wood-spirit, benzole, and bisulphide of carbon ignite instantly, without explosion. Dry blotting-paper begins to glow, with the evolution of red fumes, and cotton ignites. Guncotton and gunpowder are, however, unaffected. Ordinary illuminating gas was also ignited by it. By triturating perfectly dry permanganate of potash with dry gallic acid, ignition, with scintillation, occurred; and by trituration with tannin, ignition with flame.—6 *C, March* 19, 1873, 117.

SOLIDIFICATION OF NITROUS OXIDE.

As long ago as 1845, Faraday, by means of intense cold, succeeded in freezing nitrous oxide to a solid crystalline mass. But, unlike liquefied carbonic acid, the liquefied nitrous oxide would not freeze by the cold of its own evaporation. Thomas Wills, however, in some late experiments, has managed to obtain a sort of nitrous-oxide snow, like that of carbonic acid, by allowing the liquefied gas, mixed with a strong current of air, to flow through a fine jet. In the case of carbonic acid, as is well known, the current of air can be dispensed with.

The nitrous oxide thus solidified was rather more granular than the corresponding modification of carbonic acid, and, unlike the latter, would melt and boil before reassuming the gaseous state. In contact with the skin it produced painful blisters. Its melting-point was found to be 120° below zero. Wills also made a variety of observations upon nitrous oxide in the liquid state, when it appears to be very compressible. Its specific gravity is about nine tenths that of water. It is not mixable with the latter liquid, and it may be frozen by the evaporation produced by simply blowing a current of air through it.—21 *A*, *January*, 1874.

MIXTURE OF LIQUIDS WITH EXCLUSION OF AIR.

An apparatus for this purpose, designed by G. Schleiden, consists of a glass tube drawn out to a capillary point at one end, which is bent at a right angle, and then hermetically sealed. This end is then fused into another wider tube, which narrows toward its other end, and in which a loose fragment of glass is placed. The two tubes may be filled with different liquids, even at different temperatures, if desirable, and then fused together; and by shaking, the fine bent point of the one may be broken by the loose piece of glass, and the mixture of the liquids be accomplished.—18 *C*, *Dec.* 31, 1873, 818.

THE ACTION OF WATER UPON OZONE.

A very interesting paper has recently been published by Schöne upon the mutual action of water and ozone. Apart from the details of his experiments, his results are worth noticing, since they must be taken into account in all future speculations concerning the functions of atmospheric ozone.

Schöne finds, in the first place, that not only is ozone perceptibly absorbed by water, but that it is also partially destroyed. Even by collecting dry ozonized oxygen over a pneumatic trough, the quantity of ozone in it is diminished about one fourth. Upon longer contact of the gas with the water this loss may be increased, amounting in three days to about one half, while at the end of fifteen days every trace of ozone has vanished.

Secondly, what is the cause of this disappearance of ozone? The idea that water can be oxidized to hydrogen peroxide by the ozone is disproved. In brief, it is shown that, by con-

tact with water, ozone is gradually transformed into ordinary oxygen; the change being accompanied, as might be expected, by a corresponding expansion. By this expansion another proof is given of the fact that ozone is formed by the condensation of three volumes of oxygen to two.—33 *C, January* 19, 1874, 87.

NEW MODE OF FORMING OZONE.

Brodie, following up the line of his other recent investigations upon electrolytic action, has tested the effect of electricity upon carbonic acid gas. This gas, he finds, is partially decomposed into carbonic oxide and free oxygen, part of the latter assuming the form of ozone. The best results were obtained when a dry, rapid current of the gas was acted upon in the induction tube by electricity of feeble tension and at a low temperature. Under such circumstances, about three fourths of the oxygen set free was transformed into ozone. In one series of nine experiments, however, this limit was exceeded; from 76.6 to 85.5 per cent. of the oxygen eliminated being converted into allotropic modification. It will at once be seen that the electricity acts upon oxygen in the nascent state in order to produce such an astonishing proportion of ozone.—7 *A*, *April*, 1874, 309.

OZONE AND ANTOZONE.

We learn from the *American Journal of Science* that in a recent volume by Bellucci, professor in the University of Perugia, there is given a very interesting and valuable résumé of the researches that have thus far been made upon the subject of ozone, in which department the author has himself done valuable work. With reference to the question of the existence of antozone, the author decides, from a thorough discussion of the subject, that the theories which were expressed by many, and which have assumed an allotropic condition of oxygen antagonistic to ozone, are unsound, and that the supposed antozone has, in fact, no existence. In this opinion Bellucci anticipates the more recent researches of Engler and Nasse, who have conclusively proved that the reactions attributed to antozone were really due in most cases to the presence of hydrogen peroxide. A more recent publication of Bellucci upon the subject of emission of ozone from plants

goes to prove that the oxygen emitted by plants does not contain an appreciable proportion of ozone.—4 *D*, 1873, VI., 303.

ACTION OF OZONE ON BENZOLE.

The action of ozone upon benzole has recently been investigated by Houzeau and Thénard, who have obtained some interesting results. A variety of acid products, chiefly formic and acetic acids, are formed, and also a peculiar body, which the authors name *ozobenzin*. This body, dried in vacuo, is a solid, white, anhydrous substance, and extraordinarily explosive. Either by a blow or by heat it detonates violently, the explosion of only a few decigrammes of the substance producing such a disturbance of the surrounding air as to shake the windows of the room. In fact, it is extremely dangerous to handle, not more than three to five milligrammes being safe to keep on hand at one time. Its chemical constitution is yet to be made out.—*Ann. Chem. and Pharm.*

A NEW EXPERIMENT IN OZONE.

In a recent lecture, Dr. Andrews communicated a new experiment in relation to the formation of ozone, by which it was seen that coarsely pounded glass shaken in a vessel containing electrolytic oxygen (or oxygen that has become partially converted into ozone by the passage of the electric spark) rapidly destroys the reactions of the ozone. This experiment forms a new link between a purely mechanical action and a chemical change, closer than any hitherto observed. —12 *A*, IX., 175.

METAMERISM IN INORGANIC CHEMISTRY.

When, as frequently happens among organic compounds, two different substances have exactly the same ultimate composition in parts per cent. of the same elements, they are called in general *isomeric*. When, however, the difference between them is demonstrably structural—that is, when they contain the same elementary atoms, only differently arranged —the expression *metameric* is used. Cases of metamerism are common in organic chemistry, but until very lately not an instance of it had been discovered in the inorganic world. At the late meeting of the National Academy of Sciences in Washington, Professor Wolcott Gibbs, of Harvard Univer-

sity, announced that he had obtained a double series of no less than seven metameric bodies among the ammonio-cobalt compounds. Of these bodies he himself discovered all but the first one, which has been known for some time. All of these bodies are crystalline, remarkably stable, and very beautiful. As the discovery is one of such great interest, the formulæ are appended. In the first limb of each equation is given the rational formula, indicating the structure of the compound; in the second limb the resulting empirical formula is placed, in which the metamerism, or similar elementary composition of the bodies, becomes evident. In these formulæ Co stands for cobalt, A is a condensed expression for ammonia, and X represents nitroxyl, or the group of atoms NO_2:

1. $(Co_2A_4X_8)(Co_2A_8X_4) = 2\ Co_2A_6X_6$.
2. $(Co_2A_4X_8)_3(Co_2A_{12}) = 4\ Co_2A_6X_6$.
3. $(Co_2A_4X_8)_2(Co_2A_{10}X_2) = 3\ Co_2A_6X_6$.
4. $(Co_2X_{12})(Co_2A_8X_4) = 4\ Co_2A_6X_6$.
5. $(Co_2X_{12})(Co_2A_{12}) = 2\ Co_2A_6X_6$.
6. $(Co_2X_{12})_2(Co_2A_{10}X_6)_3 = 5\ Co_2A_6X_6$.
7. ——— $Co_2A_6X_6$, a compound long known, which seems to be really the lowest term in this double series. It will be seen that all the others are multiples of this; in bodies 1, 2, and 3, the group of atoms $Co_2A_4X_8$ occurs, while numbers 4, 5, and 6 all contain another group, Co_2X_{12}. The structure of the 7th compound has not yet been clearly made out. —*Prof. F. W. Clarke.*

ARTIFICIAL VANILLA.

Tiemann and Haarmann, on adding a ferment, in emulsion, to the coniferin extract of cambium of coniferous trees, ascertained that coniferine is separated into glucose and into a substance crystallizing into beautiful prisms, melting at 75°, and having for the formula $C^{10}H^{12}O^3$. This body, under the influence of oxidizing agents, is transformed into another crystalline body, with the flavor and odor of vanilla. This has precisely the same formula ($C^8H^8O^3$) as the aromatic matter extracted from vanilla, and presents the same reactions with it. It is, therefore, not at all impossible that in this we have another of the applications of organic chemistry to the arts by which quite an expensive substance may be

presented, in an artificial form, at much less cost, and equally adapted to its purpose.—12 *B*, *May* 30, 1874, 467.

ACTION OF ELODEA CANADENSIS (WATER-PEST) ON CANE SUGAR.

According to Schützenberger, when this plant is immersed in a solution of sugar, inverted sugar is first formed, and active butyric acid fermentation then sets in, attended with the evolution of hydrogen and the acidification of the liquid. If the plant is removed after some time, the butyric acid fermentation ceases, and alcoholic fermentation soon begins, with the formation of yeast cells in large quantities, although but few were present at first.—18 *C*, *April* 29, 1874, 266.

CHANGES IN ALCOHOLIC LIQUORS BY COLD.

According to Melsens, the taste of brandy is much improved by cooling it down to $-40°$, or even to $-22°$ to $-31°$. The viscous, sirupy, sometimes opaline mass, at the lower temperature, must be drunk from wooden cups to avoid the sensation and even the dangerous action resulting from the use of glass, and still more of metal, at that temperature. Cognac, rum, etc., were solidified by cooling them to $-40°$ or $-58°$, and in that condition, when placed on the tongue with a wooden spoon, it was astonishing how slight a sensation of cold was experienced. Indeed, the pasty mass, as it was allowed to melt upon the tongue, produced less of an impression of cold than the common water-ice of the confectioner. Many persons, in fact, could not believe that they had ice in the mouth which might have been served from vessels of frozen mercury, and that they could endure the contact of a substance cooled by the evaporation of solid carbonic acid (either alone or mixed with ether)—a substance which produces the sensation and effect of a burn upon the skin. Not until $-76°$ is reached is the frozen brandy pronounced cold by those tasting it, and even then there is no apparent discomfort experienced. At the lowest temperature employed—namely, $-96°$—the frozen brandy, if taken in sufficient quantity, produces the same sensation as that of a spoonful of rather hot soup, while if used in a metallic spoon it would have the effect of a red-hot iron. Placed upon the dry arm at this temperature, it produces a slight burn, not

as severe, however, as that by a mixture of solid carbonic acid and ether.

Sparkling wines apparently increase more in volume on cooling than still wines; and half or even two thirds of wines containing eleven to twelve and a half per cent. of alcohol can be frozen, the portion remaining liquid being at first turbid, but becoming clear by standing. The wine thus obtained is found to keep better, to be richer in alcohol and extractive matter, to possess an intensified aroma and color, and to lose, by fermentation and precipitation, albuminous matter and salts. Contrary to the conclusions of Boussingault, it was ascertained that perfectly pure water could be separated from the wine by freezing it; and the freeing of the ice formed from the adhering and inclosed wine in various ways could be best effected by centrifugal action, while the wine retained all the alcohol and mixed ingredients. Over forty per cent. of water, for example, was separated from Burgundy wine; and it is suggested that, on a large scale and with suitable apparatus, wines could be improved in this way. The character of the resulting wine can, however, only be ascertained for any particular case by a trial. But it seems established that many Burgundies may be adapted for transportation in this way, so that in bad years, or with weak wines, it will not be necessary to resort to the addition of alcohol. The two methods for the improvement and preservation of wines—namely, by heating and freezing—may, if desirable, be employed with the same article.—13 *C, August* 1, 1873, 975.

JACOBSEN'S APPARATUS FOR EXTRACTING GASES FROM SEA-WATER.

Among the finer articles used in the prosecution of deep-sea researches is an ingenious apparatus invented by Professor Jacobsen for the extraction of the gases from sea-water, and their transfer to appropriate receptacles without loss. The usual apparatus for this purpose, as heretofore adopted by Professor Wyville Thomson and others, is not considered satisfactory, the gas escaping in large quantity when the water is brought to the surface, in consequence of the reduced pressure.

Shortly before the *Challenger* left England, Jacobsen's ap-

paratus, which is somewhat complicated, was supplied for her service, and since that time two sets have been obtained from the maker, for the use of the United States Navy Department and the United States Coast Survey. In connection with this apparatus, Mr. J. Y. Buchanan, the chemist of the *Challenger*, has devised a convenient process of analyzing the gases on shipboard; the principal desideratum being freedom from the necessity of using a mercurial trough. In the January number of the Edinburgh *Philosophical Magazine* is a description of this apparatus, which is said to accomplish its object satisfactorily. The apparatus of Jacobsen is figured in Vol. CLXVII., of Liebig's *Annalen*.

CAUSE OF ACETOUS FERMENTATION.

While the investigations by Knieriem and Meyer as to the cause of acetous fermentation in the main agree in their results with those of Pasteur, they also reveal a complete analogy as to the cause between acetous and alcoholic fermentation. They regard the action of the *Mycoderma aceti*, or vinegar ferment fungus, as most probably physiological; that is to say, the formation of acetic acid is intimately connected with the general organic changes of the plant.—18 *C*, *October* 15, 1873, 666.

QUICKSILVER PRODUCT OF CALIFORNIA IN 1873.

According to the mining and scientific press of California, the quicksilver product of the state amounted to 31,881 flasks in 1871, to 30,306 in 1872, and to 28,600 in 1873. About half the total yield is from the New Almaden Mine, and next to that the New Idria, the two furnishing the value of a million and a quarter dollars. The price of quicksilver has ranged during 1873 from 90 cents (gold) in January to $1 20 in December.—*San Fran. Mining and Scient. Press*, *January* 24, 1873.

ELECTRICAL DEPOSITION OF IRON.

From a recent elaborate article on this subject, it seems that great progress has lately been made by Klein, of St. Petersburg, in electrotyping iron. He has succeeded in producing masses that can be worked as well as steel plates from engraved copper plates, combining all the softness of copper

for the engraver and the hardness of steel for the printer. It is true that the precipitated iron obtained by his process is also very brittle, and, owing to the presence of hydrogen, has a specific gravity of only 7.675; but the hydrogen can be expelled by heating, and the iron left with a specific gravity of 7.811, and perfectly malleable, very elastic, and flexible like sheet-steel, and capable of being welded—in short, a perfect wrought iron.—5 *C*, 1873, XLV., 359.

THE GASEOUS, LIQUID, AND SOLID STATES OF WATER.

Professor James Thomson, who has lately removed from Belfast to the University of Glasgow, has, in connection with his brother, Sir William Thomson, lately elaborated certain theoretical views with regard to the nature of the vapor given off by solid and liquid bodies, especially water, when near the point of congelation. A body can exist in any one of the three states—gaseous, liquid, or solid; when two of these states are present in contact together, the pressure and temperature are dependent each on the other; so that when one is given, the other is fixed. If a curved line be drawn such that the ordinate and abscissa at any point represents, respectively, the tension and the temperature, there will be, in general, three curves: one expressing the relation between temperature and pressure for gas in contact with liquid, another expressing that for gas in contact with solid, and another expressing that for liquid in contact with solid. These three curves must all meet, or cross each other, in one point of pressure and temperature, which may be called the triple point. The triple point is, in fact, what would often be called the freezing-point in vacuo. Sir William Thomson gives a formula by which the difference of the pressure of steam in contact with water, and in contact with ice, for any temperature very near the triple point, may be found, with a very close approximation to the truth, he having made the actual calculations for temperatures several degrees either side of the freezing-point of water. He has made a careful examination of the experimental results of Regnault, and finds that the observations of that eminently careful investigator give a clear indication of the truth and correctness of the formula, according to which, in any small descent in temperature from the triple point, where the pressure of steam

with ice is the same as that of steam with water, the pressure of steam in contact with ice falls off 1.13 times as much as does the pressure of steam in contact with water. It is, indeed, very creditable to the accuracy of Regnault's experiments that his results, whose slight discordances gave him considerable anxiety, are now found to contain such clear indications of this feature, which only comes to view through comparison of differences of pressure represented by very minute fractions of a millimeter of mercury; and which, unless a very high order of accuracy were obtained, might have given no perceptible indication of its existence, or might even readily have been made to disappear totally from the final results through the application of the ordinary methods for clearing off small errors of observation.—12 *A*, IX., 392.

PHOSPHORUS STEEL.

Among the results of extended experiments, conducted by Euverte, to ascertain how much phosphorus may be added to steel, the following seem important: By bringing suitable quantities of substances containing phosphorus in contact with iron of different kinds—spiegeleisen, for example—treated in a Siemens-Martin furnace, he found the resulting metal to be malleable, and generally of good quality, and he also determined that cast steel may contain a certain amount of phosphorus without losing in quality as respects its tenacity, and that steel containing 0.003 of phosphorus and 0.0015 of carbon affords most excellent rails.—32 *C*, 1874, 259.

THE DENSITY OF MOLTEN IRON.

Mr. Mallet, in pursuance of his researches in reference to seismology and the early geological history of the globe, has made some highly important experiments on the alleged expansion, in volume, of various substances, in cooling down from the liquid to the solid state. Not being able, by ordinary methods, to determine the specific gravity, in the liquid state, of a body at so high a temperature as fused cast iron, Mr. Mallet has operated by an indirect way. He used a conical vessel, whose contents were very accurately known by filling it with water and weighing it. This vessel was filled to the brim with molten gray cast iron, additions of molten metal being made to keep the vessel full, until it had attain-

ed its maximum temperature and maximum capacity. The vessel and its contents, when cold, were again weighed, and there were thus obtained the elements necessary for determining the specific gravity of the cast iron which filled the vessel when in a molten state. The result is that, whereas the specific gravity of cast iron when cold is 7.17, it is when melted only 6.65. Cast iron, therefore, is less dense in the molten than in the solid state. The statements commonly made and believed as to the floating of lumps of solid iron furnace slag upon the melted slag are examined, and reasons are given for believing that even such slags are not denser in the molten than in the solid state, and that the floating referred to is due to other causes.—12 *A*, X., 157.

VOLATILIZATION OF METALLIC IRON.

According to the journal of the Iron and Steel Institute, Dr. Elsner placed a piece of wrought iron in a closed crucible of unglazed porcelain, and exposed it for several hours to a temperature of 3000° Fahr. in a kiln. On examining the crucible when cold it was found that the iron had been volatilized, and condensed on the under surface of the lid in small needle-shaped crystals, thus proving what had been suspected, but which had never been positively known before—namely, the possibility of such volatilization.—15 *A*, *August* 23, 1873, 244.

PREPARATION OF ALUMINIUM.

Garneri, of London, prepares this metal by placing a mixture of 100 parts of alumina, obtained in the usual way from kaoline, etc., with 40 parts of charcoal, heated to redness, in retorts at a dark red heat, and leading chlorine into them from an iron gasometer lined with lead, and closed with gas-tar covered with hydrochloric acid. The volatilized chloride of aluminium formed is condensed in vessels of sheet iron, glazed internally, and is decomposed by an electrical current produced by a magneto-electric machine. The liberated chlorine is returned to the gasometer.—34 *C*, X., 76.

MELTING AN EXTRAORDINARY MASS OF PLATINUM.

The largest mass of the alloy of platinum and iridium that has ever been melted at one operation was recently

fused, at Paris, in the presence of the executive committee of the National Metric Commission. This mass of the alloy was intended to be run into a mould of such shape as to afford, eventually, a number of new line standard meters, which will all be cut from this single ingot, and it is expected that the surplus metal will even then be sufficient to make all the required new standard weights, or kilogrammes, and a number of end standard meters. The weight of this great ingot was 550 pounds avoirdupois; its length about 45 inches; its breadth, 6 inches; depth, 2¾ inches. The process of melting was facilitated by first dividing the material into small pieces; a small quantity was then melted, and to it were gradually added the remaining portions, in the form of long, thin bars. The heat required was obtained by means of an oxyhydrogen furnace fed by six gas tubes, each about one inch in diameter, and supplying the ordinary illuminating gas, and another set of tubes which furnished the requisite proportion of oxygen. The latter gas was made on the premises and stored in a large gasometer. For obtaining a sufficient blast, the power of a fifteen-horse steam-engine was employed. The time actually occupied in melting the entire mass of 550 pounds was one hour and three minutes, of which the first forty minutes were occupied in melting the first half of the material.—12 *A*, X., 130.

DETECTION OF STARCH IN MILK.

Dr. Hagar accounts for occasional discrepancies in the statements of different chemists in regard to the presence of starch in a sample of milk by the peculiar property which lacteo-proteine substances possess of combining rapidly with iodine, and thus decolorizing a solution of it. In consequence, no reaction for starch is obtainable until the milk is saturated to this point with the iodine, and by accident a chemist may stop short of this, and fail to get the reaction for starch.—13 *C*, *February* 15, 1874, 270.

QUANTITATIVE DETERMINATION OF TANNIC ACID.

The following method, by Terreil, is regarded as sufficiently trustworthy for technological purposes, although some other organic substances besides tannin act in a similar manner. It rests upon the fact that 0.1 gramme of pure

tannin will absorb 20 cubic centimeters of oxygen. A graduated glass tube, with a glass stop-cock at the bottom and a ground-glass stopper at the top, is partially filled with $33\frac{1}{3}$ per cent. solution of potash, and the substance in which the tannin is to be determined is introduced as finely pulverized as possible and wrapped in unsized paper, and the tube then closed, the temperature and barometric pressure being noted at the same time. The liquid immediately begins to turn brown, and after twenty-four hours the amount of oxygen is read off, by opening the stop-cock under water, and from it the quantity of tannin present is calculated.—32 *C*, *May* 16, 1874, 239.

COMPOSITION OF SUINT.

Besides free cholesterine present in suint, Schulze has also detected in it a compound ether, containing cholesterine and isomeric with it, which he has named isocholesterine. It crystallizes out of ether and acetone in fine transparent needles, and out of alcohol in gelatinous masses; melts at 278° to 280°, and volatilizes at a high temperature, without decomposition.—13 *C*, *May*, 1874, 604.

SAFE HYDROGEN GENERATORS.

Dr. Fresenius, with a view to avoid the dangers of explosions in hydrogen generators, which, as every chemist knows, are of frequent occurrence despite the exercise of both patience and care, has applied thereto the principle of the Davy safety-lamp. A number of discs of fine wire gauze are placed in a short glass tube, and held in position by cotton-wool pressed against them on both sides. This little tube is introduced near the exit of the gas, and prevents the explosion from extending to the wash bottle, and the generator itself.

NEW PROCESS FOR ESTIMATION OF ALCOHOL.

The latest novelty of this sort is the process devised by M. Ducleaux, which is described as follows: If to a known volume of water larger and larger quantities of alcohol are added, the density and superficial tension of the mixtures obtained are simultaneously diminished, and there is consequently an increase in the number of drops which they form

when allowed to flow slowly from an aperture of given size. If the size of this aperture is constant, so too will be the number of drops corresponding to each alcoholic mixture which flows through it in a given time. The difference between the numbers thus found is said to be large enough to furnish the basis for a very sensitive alcoholmetric method. A pipette of given volume is to be employed, the number of drops escaping therefrom counted, and the alcohol percentage estimated by tables prepared by the author for the purpose. The process is claimed to be extremely delicate.

DETECTING FUCHSINE IN WINE.

The extent to which fuchsine has lately been used in coloring wines, candies, etc., renders it a matter of some importance to detect the existence of this poisonous principle. According to a recent French writer, the simplest method of doing this is to place a portion of the suspected liquid in a test tube, and to add first 150 grains of subacetate of lead, and then 200 grains of amylic alcohol. If, after agitation of the mixture, the amylic alcohol, on separating, appears colorless, it shows that fuchsine has not been used; if, on the contrary, it exhibits a red tint, it indicates that this poisonous substance has been added.—3 *B*, *July* 30, 1874, 503.

HOT FILTERING.

A method of hot filtering, which may often be found serviceable in the laboratory, is thus described: A tube of soft sheet lead is wound about the funnel containing the filter, in the form of a spiral. One end of the tube passes through a cork in the neck of a flask, in which water or other liquid is brought to the boiling-point. The other end terminates in a receiver, into which the condensed liquid flows.

SPECTROSCOPIC CHEMISTRY.

Lockyer, in a recent communication to the Royal Society, states that he has shown that when different degrees of dissociating power are employed the spectral effects are different; and, in continuation of this same idea, he now proposes to give the reasons which led him to the conclusion that, starting with a mass of elemental matter, such mass of matter is continually broken up as the temperature, including in

this term the action of electricity, is raised. In pursuing another line of research, namely, the connection between the molecular construction of vapors and their densities, Professor Lockyer states that he has recently attempted to bring the spectroscope to bear upon the question. As an example of the behavior of vapors under different temperatures, the observations of the spectrum of dry hydrogen contained in an iron tube whose ends are closed by a plate of glass may be mentioned. The temperature reached by the furnace may be conveniently divided into five stages: First, when the continuous spectrum of the tube extends to the sodium line D, this line, however, not being visible; second, when the continuous spectrum extends a little beyond D, this line being visible as a bright line; third, when the spectrum extends into the green, D being very bright; fourth, when the spectrum extends beyond the green, and D becomes invisible as a line, and the sides of the furnace are at a red heat; and, fifth, when the tube has, by a special arrangement of Professor Roscoe, been heated to a white heat. From the examination of twelve or fourteen different substances, Lockyer shows that if similar spectra be taken as indicating similar molecular conditions, then the vapors, the densities of which have been determined, have not been in the same molecular condition among themselves.—12 *A*, X., 155.

ASSAYING WITH THE SPECTROSCOPE.

Some interesting experiments have recently been made in the Assay Department of the United States Mint at Philadelphia, by Mr. Alex. E. Outerbridge, to ascertain the practicability of assaying metals used in coinage by means of the spectroscope. The earliest experiments in this direction were made by Mr. W. C. Roberts, of the London Mint, in 1872, in connection with Mr. Lockyer, the distinguished spectroscopist, but with unsatisfactory results. Mr. Outerbridge's experiments, as detailed in a paper read before the Franklin Institute October 21, 1874, seem to establish the apparent paradox that the spectroscopic method is in one respect far too sensitive and minute, and, in another respect, far from being minute enough to serve the uses of assay. The problem to be solved is, simply stated, to utilize the spectroscope as a means of quantitative as well as qualitative analysis. The experi-

ments in question are made with the object of ascertaining the practical value of the discovery of Mr. Lockyer, upon which this observer founded a theory of possible quantitative analysis; namely, that when a powerful induction coil is employed, and the distance between the metallic electrodes is gradually increased, certain of the lines in the spectrum break in the middle; and that, upon further increasing the distance between the electrodes, the hiatuses in the spectrum lines increase proportionally, until the lines themselves finally disappear. Without entering into the details of the experiments of Mr. Outerbridge, it will suffice to state the results which he announces concerning the value of Mr. Lockyer's proposed method on a working scale. He found that the visible differences in the spectra of two alloys of considerable difference in constitution were but slightly appreciable, and that when the constitution of the two alloys whose spectra were composed was more nearly identical, the spectral differences were quite inappreciable. A variation, for example, of $\frac{1}{1000}$ required an effort of the imagination to detect any difference. Again, the quantity of metal vaporized in the process, the author claims, is too infinitesimal to give safe results for a large melt, since this would be affected by the least want of homogeneity of the alloy. He found, for instance, that the loss of metal for each spark was not more than one millionth of a grain. Another difficulty detected by the author is in the fact that while the spectroscope is very sensitive to pure metals, a comparatively large quantity of gold may be present in an alloy and the spectroscope not indicate its presence. He states that in an alloy of gold and copper containing from 200 to 250 parts of gold, the gold spectrum is barely visible, and the same want of sensitiveness holds good with other metallic alloys. His conclusions are announced in the following words:

"It is not impossible that future discovery may succeed in explaining this anomaly, in harmonizing apparent inconsistencies, in eliminating the sources of error, and in reducing the operation to more practical certainty; but in the present state of spectroscopic science, so far as I have been able to perceive, I have arrived at the opinion, not without regret, that assaying by means of spectrum analysis is impracticable for the purpose of mint operations."

TEMPERATURES IN PNEUMATIC STEEL MAKING.

According to Kraus, the flame enters the Siemens-Martin furnace at a temperature of about 3000° C. (over 5400° Fahr.), and the furnace itself acquires a temperature of 1800° C. (3243° Fahr.). These figures may be taken as the maximum. In the Bessemer converter a higher temperature is possible—say 2500° C. (4500° Fahr.); since the carbonic oxide formed by the combustion of the carbon of the cast iron is not so readily dissociated at high temperatures as carbonic acid, and the burning silicon remains in the metal bath as silicic acid. The small neck of the converter aids the accumulation of heat by effecting an increase of pressure, which, in turn, retards dissociation.

ALUMINIUM IN PLANTS.

It has been known for some time that while the metal aluminium is found in a few of the cryptogamous plants, it is not to be detected among flowering ones. Professor A. H. Church has been recently investigating this subject, and publishes the result in the *Chemical News*. So far he has found this element in four species, and in the following proportions:

	Percentage of Ash in Dry Plant.	100 parts of Ash contain	
		Silica.	Alumina.
Lycopodium alpinum..........	3.68	10.24	33.50
L. clavatum..................	2.80	6.40	15.24
L. selago.....................	3.20	2.53	7.29
Selaginella Martensii.........	11.66	41.03	0.26

—1 *A*, *September* 18, 1874, 138.

REDUCING RICH IRON ORES.

Dupuy's direct process is described as a new method of reducing rich iron ore from its oxide to cakes of comparatively compact metal at one heat. These are then withdrawn, and at the same heat forged for wrought iron, while for steel purposes they are thrown, without forging, into the molten bath of the Siemens furnace, or cut up and melted in pots. The ore is used as ordinarily prepared for the common forge fire. It is mingled with the proportion of pulverized charcoal found requisite for complete reduction, which is but a

few bushels to the ton of iron. It is then placed in thin sheet-iron canisters of any convenient, portable size, holding, each, say from 100 to 200 pounds. Many of these, to the extent of several tons, are subjected to the proper degree of heat in a peculiar but inexpensive furnace, where in a short time the operation is completed. After reduction, which is the first stage, the iron is left in a porous, cellular condition, by the exit of its oxygen. The increasing heat then gradually softens it to the pasty state, when by its own weight it settles and consolidates, thereby not only closing its cells or spaces from the inroad of furnace gases, but pressing out much of its impurities, which have become liquefied, and flow away from the metal. It is well known that in a few hours, by properly proportioning the carbon, rich ore may be reduced either to the malleable state for forging, or to cast iron, at pleasure, in an ordinary covered clay crucible, and nearly all the metal may be saved. This new process simply substitutes sheet iron for the clay crucible. The sheet-iron crucible protects the metal equally well in its transition state, and has the advantage of being homogeneous with the mass, and finally is worked up with it. As the iron comes from the fire surrounded with its incasement, it is found to have lost by deoxidization more than one third of its original weight, while it is only about one quarter of its original bulk. In this condensed, solidified condition it is well fitted for economical transportation to distant points, there to be forged for iron or melted for steel.

The small cost for plant warrants the production of this metal wherever the crude materials may be cheapest collected, but where the erection and operation of extensive machinery for after-working is necessary, may be inconvenient and inadmissible. The asserted superior quality of this charcoal malleable iron over northern blooms, for forging or for steel, added to its more economical consumption of fuel, ore, and labor, seems to commend it.

E. MINERALOGY AND GEOLOGY.

STRUCTURE OF THE EARTH.

An elaborate paper, presented by General Barnard to the Smithsonian Institution, on the internal structure of the earth, deduces the following conclusions: That, whereas the analysis of Professor Hopkins seems to establish that the rotation of the solid crust imparts to the fluid nucleus a motion nearly, if not quite, as rapid as its own, and the fluid thereby acquires a proper rigidity, by which it reacts upon the shell as if it were a solid mass, this pressure tends to preserve the earth's nutation and precession unchanged. If the fluid be heterogeneous, the same rigidity is attained, and the powerful pressure that would be exerted upon the thin, rigid shell would probably produce no noticeable changes; while, if the shell be not of a rigidity far surpassing that of the known constituents of the crust, the precessional motion of the earth would, owing to the neutralizing effect of tidal protuberances, be scarcely observable.—*Proc. Am. Assoc., in N. Y. Trib.*, 1873.

NATIVE TELLURIUM IN COLORADO.

One of the most interesting results of the examination of sundry minerals collected during the geological survey of Professor Hayden, in 1873, according to Dr. F. M. Endlich, one of the geologists of the expedition, consists in the fact that native tellurium was found among some of the tellurides from the Red Cloud Mine at Gold Hill, Colorado. It occurred in a specimen weighing about six pounds, a mechanical mixture of quartz and native tellurium in equal proportions. Except in Transylvania, tellurium has never been found in its native state. Small admixtures of bismuth, selenium, iron, gold, and silver are associated with it, so that the tellurium is only about ninety-one per cent. of the mineral.

THE MOLECULAR STRUCTURE OF METEORIC IRON.

Dr. J. Lawrence Smith, of Louisville, Kentucky, in a recent article on the meteor of Howard County, Indiana, states that his own conviction is that we shall not arrive at a satisfac-

tory explanation of the so-called Widmannstättian figures until our knowledge of the effect of a minute quantity of foreign substances in iron is better understood than now, a subject which investigators in both pure and technical chemistry are now studying with great interest, in order to discover how far those substances, usually called impurities in iron, are to be regarded as hurtful. Very small proportions of these supposed impurities often introduce important modifications in the nature of the iron. For instance, one per cent., or less, of phosphorus so far modifies cast iron that it will resist the action of concentrated sulphuric acid to a greater degree than when entirely free from phosphorus; and those who separate silver and gold by the sulphuric-acid process find that some cast-iron vessels are destroyed in a few weeks, while others will last for years. Phosphorus also modifies the physical properties, imparting to the iron more fluidity when in a melted state, and furnishing more compact castings. In regard to the Widmannstättian figures, he states that it is his belief that in the crystallization of iron, as in the crystallization of all other substances containing impurities, there is a tendency to eliminate the foreign constituents to the exterior portion of the crystals, and it is between the crystals, and contiguous to their surfaces, that we find the greater part of the foreign constituents mixed with more or less of the predominating materials. In meteoric iron, which always contains phosphorus, it may be safely premised that if the iron pass slowly into the solid condition, and is therefore allowed to crystallize more or less perfectly, we may expect, in certain parts of the mass representing the spaces between the crystals, to find a more or less perfect elimination of the phosphorus, thus destroying the homogeneous character of the mass, and rendering its different parts variously susceptible to the action of chemical agents, and so producing that mottled surface known as the Widmannstättian figures.—4 *D*, 1874, 392.

A BISMUTH MINE IN FRANCE.

For two or three years past a bismuth mine has been worked at Meymac (Corrèze), in Central France. The vein occurs in one of the ramifications of the granitic chains separating the basins of the Vienne and the Creuse from that of the Dor-

dogne. The vein is of quartz, traversing a very coarse porphyric granite, and contains, in addition to bismuth, the minerals of tungsten, iron pyrites, and some ores of lead. The bismuth occurs native in the sulphide, and as subcarbonate, the latter ore predominating. In this respect the mine seems to differ from all other mines hitherto worked, the difference having led to the adoption of a new method for extracting the metal. The finely crushed mineral is several times treated with hydrochloric acid, and the valuable portions of the mixed ores thus dissolved. Into the filtered solution, which should be but slightly acid, bars of iron are introduced, by which means the bismuth is entirely precipitated as a heavy, black powder. This powder is quickly washed with pure water, and, before it has time to oxidize in the air, is compressed in a mould and dried rapidly in an oven. The dried mass is then fused in a closed black-lead crucible under a thick layer of charcoal for about three quarters of an hour, and is afterward cast into ingots. The metal, thus obtained, contains traces of lead, of arsenic, and of antimony, and can be purified in the ordinary way. The new method of extraction has thus far served very well, the loss of metal being much less than by the older processes. Loss by volatilization is especially avoided. Up to this time the new mine has furnished about two hundred and fifty kilogrammes of bismuth to commerce, this product being mainly consumed in Central France for pharmaceutical purposes.—1 *B*, *February* 22, 1874, 352.

MALLET'S OBSERVATIONS ON THE PROPERTIES OF ROCKS.

The general seismic views of Mallet have already been partially presented to the world in various publications, but it is only lately that the complete memoir presented by him to the Royal Society has reached America. Passing by those views which may be considered more or less theoretical, although apparently very firmly established, we come to the experimental determinations that have occupied so much of Mr. Mallet's time, and that must ever remain an invaluable contribution to our knowledge of terrestrial physics. The two great questions, he states, that are to be answered, are how much heat is produced by the crushing of a given weight or volume of rock, and whether the total amount of

crushed rock, or the heat due to it that we can estimate as probably occurring within a thousand years, be adequate to account for the volcanic phenomena that may take place during that period. The mechanical work expended in the deformation or the disintegration of a solid must all reappear, either as heat or as external work of some sort, and the experimental determination of the heat thus produced was undertaken by Mr. Mallet on a large scale. Within a very small limit of error, he found, both theoretically and practically, that the whole of the work consumed in crushing matter, like rock, reappears as heat, the amount of which can be calculated by the use of Joule's mechanical equivalent. The experimental verification of these theoretical calculations was only possible by means of a magnificent crushing-machine belonging to the locomotive works at Crewe, which consisted of a large balanced wrought-iron lever, so constructed that it could be used for producing compression, tension, or torsion, the load itself being produced by water flowing into a cylindrical iron vessel suspended to the long arm of the lever. Sixteen varieties of rock, from various parts of Europe and Great Britain, were experimented upon, half a dozen cubes of each kind being prepared. The specific heat of the cubes experimented upon, as well as their specific gravities, were accurately determined. The specific heats of rocks have been so rarely ascertained that special interest attaches to Mr. Mallet's results. The lowest specific heat found by him is 0.180, being that of the Dartmoor red granite. The largest specific heat is 0.284, being that of Caen stone, a variety of oölite. A second series of experiments, and those of apparently considerably greater delicacy and difficulty, were for the purpose of determining the total amount of contraction of the solids constituting the shell of the earth, upon cooling from their temperatures of fusion down to their present condition. In this class of experiments certainly none have ever been made that attained to the reliability of Mallet's results. To conduct his observations properly, Mr. Mallet was able to make use of the furnaces of the Barrow Works, Cumberland County, and the experiments were made upon a very large scale. He finds that the co-efficient of cubic contraction for the slag experimented upon, between the temperatures of 3.680° and 53°, is

nearly 0.067; and he states that the earth's diameter, being at present 7916 British miles, it must, when liquid, have been a globe 8105 miles in diameter, and when at the temperature of incipient consolidation, it must have been 7957 miles in diameter. The earth, therefore, between its period of liqnidity and its present state, has shrunk in diameter by 189 miles at the least.—*Phil. Trans. Roy. Soc.*, CLXIII., 187.

THE LINES OF ELEVATION IN THE EARTH'S CRUST.

Mr. Angns Ross, of Halifax, announces a generalization deduced by himself with regard to the lines of elevation on the earth's crust, which is well worthy of close criticism and careful examination. He claims to have discovered that the various mountain chains, or line of anticlinal elevation, are ranged in parallel lines along certain belts or zones, which girdle the earth, each zone following, approximately, the course of a great circle, and each having for its medial line or axis a line of volcanoes. Of these zones he describes seven. The following description of one may serve as a type of the rest:

"The Rocky Mountain system has its axial line in the volcanic belt extending from the Middle Andes, inclusive, across Central America, along the Rocky Mountains, Alaska, the Aleutian Islands, Kamtschatka, the Kurile Islands, Japan Islands, Loo Choo Islands, Philippine Islands, Palawan, and Borneo. The islands of Amsterdam and St. Paul, the Kerguelen Islands, the South Sandwich Islands, and South Georgia, seem to indicate the completion of the more southerly part of the great circle." The author describes seven such zones or belts, and argues that their intersections constitute a foci of volcanic energy. He also maintains that the great mountain chains, in their directions, follow the course of one or other of these zones.—12 *A*, IX., 380.

THE FORMATION OF THE EARTH'S CRUST.

In an inaugural of Dr. Lang there is a theory of the formation of the earth's crust that will be of interest in these days, when Mallet's theories are so ably defended and controverted. According to Lang, as the fluid mass cooled and crystallized or solidified, there occurred immediately a sensible expansion, the specific gravity became a minimum, and the stone was

therefore lighter than the original liquid. The compressions experienced in the cooling crust of the earth are, in general, the cause of the phenomena of splitting and crushing observed among its strata. In fact, the expansion of the original liquid, as it solidified, predisposes in the mass a condition favorable to the phenomena of segregation, as shown in basalt and in various concretions.—*Inaugural Diss., Halle.*

RELATION OF MAN'S EXISTENCE TO THE GLACIAL PERIOD.

There has been a question whether man actually lived in Europe before the glacial epoch, Mr. A. R. Wallace contending that there is no evidence of it, and that, even if he did, the action of the ice-sheet would probably have obliterated all record of his existence. Some light has been thrown upon this problem by the results of the examination of the Victoria Cave, near Settle, in Yorkshire. A careful exploration of a bone-bed in the cave, situated at a considerable depth below the other deposits, brought to view hyena-dung, broken bones, and teeth. Among other objects found in this deposit were the remains of the mammoth, two species of bear, the cave hyena, the woolly rhinoceros, the bison, and the stag—representing the fauna of the river gravels of the south of England.

Among the articles found was one bone which was not identified at first, but which has lately been determined by Mr. Busk to be a portion of an unusually clumsy human fibula, similar to the same bone in the Mentone skeleton. There appears to be no question of the contemporaneity of this bone with those just mentioned. The most interesting point connected with this discovery, however, is the fact that the edge of the bed containing the human bone and those of the other mammalia named is overlaid by a bed of stiff glacial clay containing ice-scratched boulders. This is covered by a great thickness of talus from the superincumbent cliffs, which itself has been accumulating for a very long period of time. This clay is probably the remains of a lateral moraine left by a glacier or ice-sheet, which would show that the remains of the older mammals and of man are of an age anterior to the great ice-sheet of the Irish Sea basin. The complete absence over co-extensive areas in the north of Europe of the paleolithic implements occurring in the south seems to

indicate the removal of paleolithic man from those areas by the ice-sheet, and appears to carry the period back anterior to the ice-sheet—that is, to interglacial, if not preglacial, times. —12 *A*, *November* 6, 1873, 14.

PROGRESS OF THE GEOLOGICAL SURVEY OF CALIFORNIA.

Professor J. D. Whitney has published a statement of the progress of the Geological Survey of California for the years 1872 and 1873, showing a very great result for the very moderate appropriations made by the state for this purpose. The members of the survey have been chiefly occupied in completing the topographical surveys for the series of maps, of which quite a number have been published. Those that have appeared are masterpieces of clearness and artistic merit, and are well worthy of imitation by those who have similar enterprises in charge.

The announcement is made that the series of natural-history reports is in a state of as great forwardness as the means at command will permit; and it is hoped that all but the botanical volumes will be printed before the end of the next year, as well as the second part of the ornithology, embracing the water birds. The fossil plants are in the hands of Professor Lesquereux, and will constitute the third volume of the paleontological series.

Additional material in reference to the vertebrata and the shells of the state has been brought together, and awaits further appropriations. There yet remain five to seven volumes to complete the reports on the original plan, four volumes already having been published, and taking high rank as standard works.

The unfinished volumes can all be ready for presentation, should the necessary appropriations be made, by the 30th of June, 1875.

TSCHERMAKITE.

A new mineral, named after the mineralogist Tschermak, has been described by V. Kobell. Its locality is Bamle, in Norway. It is a highly lustrous, cleavable mineral, of specific gravity 2.64, and belongs to the class of feldspars. When heated, it emits a whitish, phosphorescent light.—18 *C*, *February* 18, 1874, 103.

THE VERMICULITE GROUP OF MINERALS.

Professor J. P. Cooke, Jr., of Harvard University, has published in the Proceedings of the American Academy of Arts and Sciences an interesting description of this mineral group. The old name, vermiculite, he applies to the whole group, instead of to merely one species, and classes under it the three minerals jefferisite, culsageeite, and hallite. The last two names are new, being applied, the one to a mineral from the Culsagee Mine, in N. C., the other to a micaceous substance from East Nottingham, Pa. All three resemble the micas, and exfoliate remarkably when subjected to heat. The bulk of the paper is taken up with the chemical and optical relations of these minerals, their resemblance to other micas being carefully pointed out.

HORBACHITE—A NEW MINERAL.

A new ore of nickel, described by Knop, has been found in the mines of Horbach, in the Black Forest. Its composition in per cent. is—nickel, 11.98; iron, 41.96; sulphur, 45.87. This shows it to be, in all probability, a mixture of the isomorphous trisulphides of iron and nickel, of a somewhat variable character. It seems, from a chemical point of view, to be really a unique species, no similar constitution having ever been observed among native sulphides. The new mineral, for which the name *horbachite* is proposed, resembles magnetic pyrites or pyrrhotine in many respects. It forms irregular nodules, of specific gravity 4.43, decidedly magnetic, and of a pinchbeck-brown color inclining to steel-gray. It seems to yield up its nickel quite freely, and to be a really valuable ore.—*Jour. Chem. Soc., January*, 1874, 34.

SCHRÖCKINGERITE.

A new mineral, bearing the above name, has been described by Schrauf. It occurs at Joachimsthal, in small, soft, thin, six-sided plates, implanted on pitchblende. Its color is a light greenish-yellow, and its composition shows it to be a calcio-uranic carbonate. Outwardly it resembles the micas, and it differs in its optical and crystallographic properties from all the calcio-uranic carbonates hitherto known.—21 *A*, *February*, 1874, 134.

NATIVE TELLURIUM IN COLORADO.

One of the most interesting results of the examination of sundry minerals collected during the geological survey of Professor Hayden in 1873, according to Dr. F. M. Endlich, one of the geologists of the expedition, consists in the fact that native tellurium was found among some of the tellurides from the Red Cloud Mine at Gold Hill, Colorado. It occurred in a specimen weighing about six pounds, a mechanical mixture of quartz and native tellurium in equal proportions. Except in Transylvania, tellurium has never been found in its native state. Small admixtures of bismuth, selenium, iron, gold, and silver are associated with it, so that the tellurium is only about ninety-one per cent. of the mineral.

BEDS OF SULPHUR IN ICELAND.

The discovery of immense beds of sulphur in Iceland bids fair to make a material change in the trade in that substance, the Italian mines, according to recent accounts, having become to a considerable degree exhausted. An Englishman, Mr. Locke, has purchased six square miles in the region adjoining Lake Myvatn, in which are mountains of almost solid sulphur, the yellow color of which is visible at a great distance.—13 *A*, *July* 25, 1874, 97.

"MINERAL BUTTER."

Schwarz, chief of an astronomical expedition to East Siberia, obtained there a white salt, in form of globules about the size of pease, and grouped in clusters, the source of which, according to the natives, was the schistose rock on the banks of the Yenisei River, and employed in dressing wounds. Fragments of adhering rock confirmed the statement of its origin. It was almost completely soluble in water, the residue left consisting of a mixture of basic sulphates of alumina and sesquioxide of iron, while the liquid, possessing a strongly acid reaction on litmus, contained, in addition to the neutral salts of these sesquioxides, a considerable quantity of the sulphates of magnesia and ammonia, with some sulphates of lime and soda, and traces of sulphate of potash and chloride of sodium. A white salt similar to the above was ob-

served by Duhmberg, medical inspector, as a product of decomposition, incrusting the almost vertical dark-gray schistose rock on the banks of the Irtish, which was called mountain-butter by the natives, and also used by them as a sedative for wounds and an astringent. The adhering rock, inclosing microscopic crystals of pyrites, indicated its origin and mode of formation very clearly; and chemical analysis by Schmidt showed that, although similar in other respects to the Yenisei salt, it contained a much larger amount of sulphate of lime in place of sulphate of ammonia, which was entirely wanting. Both seem to result from the oxidation of the sulphurets accompanying the feldspathic and angite rocks, and the decomposition of these rocks by the nascent sulphuric acid formed.—18 *C, May* 13, 1874, 300.

COMPOSITION OF FULGURITES.

Fulgurites or sand-tubes, usually regarded as formed of silica, fused by electrical discharges, according to analyses by Scholz, consist essentially of carbonates of the alkaline earths, about 85 per cent. being carbonate of lime, and 11 per cent. carbonate of strontia.—14 *C*, CCXI., 408.

ATMOSPHERIC DUST.

M. Tissandier has lately been prosecuting extended inquiries into the character and amount of atmospheric dust precipitated upon given surfaces, and finds occasion to conclude that this amount is quite enough to play an important part in the physics of our globe. This dust he found to contain one third of combustible organic matter and two thirds of mineral matter. Iron is almost always present, and this, in M. Tissandier's opinion, has an important bearing upon the question of iron meteorites. He thinks also that a considerable part of this atmospheric dust is received from the planetary space.—3 *B, April* 2, 1874, 623.

GEOLOGICAL COLLECTION AT THE CENTENNIAL EXPOSITION.

With a view of properly exhibiting the geological and metallurgical resources of America at the forthcoming exposition at Philadelphia, an association has been organized, embracing such names as those of Professor Lesley, Professor Genth, Professor Raymond, Professor T. Sterry Hunt, Pro-

fessor George H. Cook, and others, to whom is to be intrusted by the Board of Centennial Commissioners the duty of collecting whatever will best answer the purpose in question. They have established an office at No. 265 South Fourth Street, Philadelphia, where they propose to bring together the collections, and to make a suitable selection for transfer to the Centennial establishment. Producers and consumers of iron ore and other minerals are invited to call and ascertain the plans and progress of the association.

DISTRIBUTION OF VOLCANOES.

Henry Howorth some time ago contributed to *Nature* an interesting letter in reference to the distribution of volcanoes on the earth. He adduces abundant evidence—namely, the testimony of many Russian and other travelers—to show that Humboldt was quite in error in supposing that a region of volcanoes and volcanic action existed in the interior of Asia. Fires, indeed, are found there, produced by the ignition of seams of coal and of streams of carbureted hydrogen gas, but of volcanoes proper there is not a trace, either in the interior of China or in the region of the Himalaya Mountains. With the establishment of this fact disappears the only exception known to the rule that volcanoes, instead of being found chiefly on areas of elevation, are invariably found in areas of depression, or close to the boundary-lines which separate them from the areas of elevation. This general rule seems to be first distinctly established by Howorth's inquiry, the result of which is that all the large land surfaces of the earth —the large continental and insular surfaces—are more or less in process of gradual or rapid elevation. There are a few small areas of depression on the outskirts and borders of the great land masses, but these are very local and unimportant, and with this slight exception the continents of America, Asia, Europe, Africa, and Australia are all more or less rising. This necessitates a corresponding sinking of the surfaces covered with water. Evidences of this latter fact are not easy to find, although they exist. Having shown this generalization, the fact becomes still more striking that we shall search in vain among the large areas of upheaval, except along their boundaries and fringes, for any active volcanoes. —12 *A*, 1874, IX., 142.

AGE OF CENTRAL AMERICAN GOLD DEPOSITS.

Professor William M. Gabb, of Philadelphia, who is at present engaged in an exhaustive geological exploration of Costa Rica, has lately made a very important discovery in reference to the sedimentary rock on the Atlantic slope of Costa Rica; namely, that even such portions as are auriferous are not of earlier age than the tertiary. Indeed, in Professor Gabb's opinion they are of miocene age, which is, of course, strongly in contradiction of the hypothesis of Sir Roderick Murchison that gold is of silurian origin.

NEW GUANO DEPOSITS IN PERU.

The great diminution in the supply of guano on the Chincha Islands, consequent upon the extent to which this substance has been transported to all parts of the world, has had a very unfavorable influence upon the credit of Peru, this constituting the principal resource of the country, enabling it to undertake and carry on its vast system of internal improvements. For the purpose, therefore, of determining exactly what may be looked forward to in this respect in the future, a government commission has been quietly engaged for some time, and has lately made a report. In this we are informed that not only are there other guano islands yet undisturbed, but that with the amount discovered at various points on the main-land the supply may be considered as practically inexhaustible. At a place called Pabellon de Pica the deposit is estimated at six millions of tons; at Point de Lobos, two millions, and in other places two millions more.

It appears that the inland deposits were worked by ancient Indians, as in them were found galleries extended as in mines, with pillars left to support the roof. Many remains of implements, idols, etc., were also met with. The depth of the guano in some places amounted to ninety-seven meters, and many of the beds were overlaid with calcareous strata. —*Panama Star and Herald, November* 7, 1873.

GEOLOGICAL SURVEY OF PENNSYLVANIA.

A law was enacted by the Pennsylvania Legislature, on the 14th of May, providing for a new geological survey of

the state; this to consist of two divisions, one embracing the state geologist and his special scientific assistants, the other the business department, constituted by ten commissioners from different parts of the state, who, with the governor, act as a supervisory board. This board is to meet at Harrisburg every three months to supervise the execution of the work, and their indorsement is necessary for the initiation of any particular undertaking, although, when authorized, there is to be no subsequent interference with the chief geologist in carrying it out.

Three years are allowed for the completion of the work, and $35,000 per annum is appropriated. A cabinet of specimens of geology and the mineral resources is to be gathered, for ultimate exhibition. Nine assistants have been appointed by Professor Lesley, each with his special corps, with the view of more rapidly accomplishing the objects of the survey.

For the coming year the investigations are to be of the primary ores of York and Adams counties, the limonite ores of the Lehigh Valley, the fossil ores of the Juniata Valley, the bituminous coal-fields of Clearfield and Jefferson, and the oil region of Butler, Clarion, and Venango counties. A review of the upper oil region is to be completed during the present season; possibly also a portion of the anthracite coal region. A special laboratory for iron ores, and iron and steel, is to be established at Harrisburg, together with suitable rooms for the museum. Dr. Genth has been appointed mineralogist of the survey.

GEOLOGICAL SURVEY OF WISCONSIN.

The newly organized geological survey of Wisconsin is now in its second year of field work, under Professor J. A. Lapham, and promises to do good service in the development of the industrial and economical resources of the state. At present the work is in progress in Portage County under the charge of Mr. Roland Irving, in Manitowac under C. C. Chamberlin, and in Green County under Moses Strong.

The enactment under which the survey is prosecuted became a law on the 19th of March, 1873, and it is provided that a full series of the geological collections shall be deposited with the Wisconsin Academy of Sciences, with the State

University, and with the different colleges of the state and the normal schools, provided an application be made to the chief geologist before the commencement of the field work. The service is to be completed within four years of the time of its commencement.

DR. GENTH ON CORUNDUM.

An important memoir, constituting No. 1 of the Contributions from the Laboratory of Pennsylvania, has lately been published by Dr. F. A. Genth upon corundum, its alterations and associated minerals.

REPORT, FOR 1873, OF THE STATE GEOLOGIST OF NEW JERSEY.

The annual report of the state geologist of New Jersey for 1873, which has just appeared, contains a notice of the work done by Professor Cook, the chief geologist, and his assistants. This embraces the result of surveys of various portions of the state for the purpose of determining their mineral products, the survey of the northern boundary of the state, and various measures connected with the drainage of submerged lands. A geological map, on a large scale, of the northern half of the state accompanies the volume, and forms a valuable contribution both to the geology and geography of New Jersey.

Professor Cook calls attention to the extensive use made during these surveys of the dipping-needle, for determining the location of concealed beds of iron ore; this, in his opinion, being a valuable adjunct, and capable of practical application.

GEOLOGICAL SURVEY OF LOUISIANA.

A very notable enterprise of the New Orleans Academy of Sciences some years ago, in the absence of any state arrangement for the purpose, was the initiation of the geological survey of the State of Louisiana, with a view of obtaining a general idea of its mineral resources, and of making observations in regard to its agriculture, topography, and natural history. Professor E. W. Hilgard, an eminent geologist and chemist (and, we believe, a brother of Professor J. E. Hilgard, of the United States Coast Survey), volunteered to take charge of the work, in which he was assisted by Dr. J. R. Walker and Mr. F. Scott Miller.

Several months were spent in 1869 in the investigation, the results of which have just been published by the society in a pamphlet of forty-four pages. The topography, the peculiar features of Attacapas and other prairies, the Calcasieu Prairie, Lake Charles, Sabine Parish, the Red River, and other important regions in the state, are all passed in review, and much information of especial value is presented.

Professor Hilgard states in general terms, as the result of his researches, that the geological formation of Louisiana lying west of the main axis of the Mississippi Valley is more or less accurately the reflected image of that of the states of Mississippi and Alabama east of the same.

DR. HAYDEN'S BULLETIN.

Dr. Hayden, the head of the Geological and Geographical Survey of the Territories, has commenced the publication of a bulletin to communicate such announcements of new facts made by any member of his party as it is desirable to bring promptly to the notice of the scientific community in advance of their publication in his reports. The first number of this bulletin, bearing date January 21, is occupied by a list of the members and collaborators of the survey for 1873, and a list of the publications, from which we learn that six volumes of the reports have appeared from 1867 to 1873, and that seven volumes of miscellaneous publications will be published in octavo form, the most elaborate being the hand-book of the ornithology of the Northwestern Territories, by Dr. Coues; several quarto volumes will also be sent out, of which there have been actually published one by Professor Leidy, on the extinct vertebrata of the Western formations, and one on the Acrididæ of North America by Professor Cyrus Thomas. This quarto series, it is expected, will include ten volumes, among them memoirs on the vertebrata of the cretaceous and tertiary formations, by Professor Cope; one each, on the fossil plants, by Professor Newberry and Professor Lesquereux; on the fossil invertebrates, by Professor Meek; and the volume on general geology, by Professor Hayden.

Thirteen maps have been published for the survey, those of the Yellowstone region being especially valuable. The body of the bulletin is occupied by a report on the stratigraphy and pliocene vertebrate paleontology of Northern

Colorado, by Professor Cope, in which he presents the parallelism of the formations recently investigated by him with those earlier known and in other parts of the West. He concludes that, although these formations have generally been considered as tertiary, the geological evidence shows them to be strictly mesozoic, as in the great lignite formations on the Missouri River.

During the past season twenty-one new species of vertebrates were obtained in the pliocene sandstone at the head of the water-shed between the South Platte River and the Lodge-pole Creek. The most important result was, first, the discovery that the camels of that period possessed a full series of upper incisor teeth; second, that the horses of the genus *Protohippus* are, like those of *Hippotherium*, three-toed; third, that a mastodon of the *M. ohioticus* type existed during the same period.

FINAL REPORT UPON THE GEOLOGY OF OHIO.

We have already given a notice of the appearance of the first volume of the final report upon the geology of Ohio, by Professor Newberry, and we have now to chronicle the publication of the first volume of the series of reports on the paleontology, a work of very great scientific value. It embraces three sections: first, a description of the invertebrate fossils of the Silurian and Devonian system, by Professor F. B. Meek; second, descriptions of the fossil fishes, by Professor Newberry; and, third, descriptions of fossil plants, also by Professor Newberry. This volume is fully illustrated by forty-eight plates, representing the new and more interesting species. As the first systematic account of the fossil remains of the state, this volume has a special importance, since, although descriptions of a large number of species have been actually published, they are scattered through the transactions of societies and scientific serials at home and abroad, requiring a large library for their study. The concentration of this information in the volumes of the report, with new descriptions and figures, together with large numbers of new species, brings the means of prosecuting such inquiries within the reach of any one.

Reference is made by Professor Newberry, in his introduction, to some interesting points connected with the vertebrate

fossils of the state; among others to the discovery, by Mr. J. H. Klippart, of twelve nearly complete skeletons of the fossil peccary—*Dicotyles compressus*—a species hitherto known only from scattered fragments. A full account of this species is promised in the succeeding volume.

NEW MINERALS.

Among the new minerals discovered and described during the year 1874 is one known as *Rivotite*, which occurs in regular masses disseminated through limestone in Lerida, in Spain. Another, *Livingstonite*, has been found in the State of Guerrero, Mexico, and according to Barcena, its discoverer, it is a double sulphide of mercury and antimony.

Foresite is another new mineral, from the Isle of Elba, discovered by Professor Von Rath, of Bonn. This is a hydrous silicate of alumina, lime, and soda.

Veszelyite is described by Professor Schrauf, of Vienna. It is a hydrated phosphate of copper, of a bluish-green color, and crystallizing in the triclinic system. It occurs in garnet, at Morawitza, in the Banat.—16 *A*, *October*, 540.

OPTICAL STRUCTURE OF CRYSTALS.

Professor Cook, of Harvard College, in a most elaborate investigation into the crystallographic chemical relations of the vermiculites and the micas, has arrived at some results, quite new, and entirely unexpected, in relation to the optical phenomena of crystals. He states that the facts noted by him most distinctly suggest the theory that the optical phenomena of quartz are produced by a molecular structure similar to that by which we have obtained identical phenomena in artificial plates of mica, and that the two orders of crystals are aggregates of compound molecules whose parts are *twinned* together, in the one case in right-handed, and the other in left-handed spirals, and that the simple molecule, if developed normally, would produce a bi-axial structure. This theory is most markedly in harmony with the chemical relations of silica.—4 *D*, VII., 435.

GEOLOGY OF THE SIBERIAN STEPPES.

According to Mr. Thomas Belt, the steppes or great plains of Siberia are by no means of marine origin, as has been

maintained, this view being negatived by the absence of sea-shells and by the occurrence in quantity of *Cyrena fluminalis.* On the contrary, he regards these plains as deposits from a great expanse of fresh water, kept back by a barrier of polar ice extending far toward the south. In its greatest extension this ice barrier would produce the crushing of the bed rock, and, as it retreated, the water coming down from the higher ground in the south would cover a continually increasing surface.

The present character of these steppes, as seen in a section at Pavlodar, exhibits fifty feet of sand and silt, with occasional lines of pebbles. These stones become larger as we advance southward, until the soil is full of large angular quartz boulders. Farther south the bed rock comes to the surface in ridges and low hills, increasing in height until some of them attain two thousand feet. All the rock surfaces are much shattered, as if by the action of frost, but they show no sign of glacier action.—16 *A*, *October*, 1874, 546.

FIFTH ANNUAL REPORT OF THE GEOLOGICAL SURVEY OF INDIANA.

The fifth annual report of the Geological Survey of Indiana, for 1873, as prosecuted by Professor E. T. Cox, State Geologist, and his assistants, Professor John Collet, Professor W. W. Borden, and Dr. G. M. Levette, has made its appearance.

A portion of the present volume is occupied by a report upon certain interesting geological matters connected with the Vienna Exposition; next follows a paper on the manufacture of Spiegeleisen, by Hugh Hartmann; and then the report proper, by the Professor and his assistants. Several counties are taken up in detail; first, as to surface geology; then in regard to local details, their economical geology and archæology also being treated of. Several maps accompany the volume, the most important of which is that of Knox and Gibson counties.

DISCOVERY OF COAL IN SPITZBERGEN.

The discovery of large beds of coal in Spitzbergen is announced as having been recently made by the captain of the schooner *Samson.*—12 *A*, *October* 8, 1874, 472.

F. GEOGRAPHY.

COAST-SURVEY MEASUREMENTS OF MERIDIONAL LINES.

Mr. Hilgard, assistant in charge of the Coast Survey office, has communicated to the American Association the general results of the measurements made by the Coast Survey of two meridional lines, one extending from Farmington, Me., to Nantucket, and the other from the head of Chesapeake Bay to Ocracoke, North Carolina. The result of his comparison between the measured lengths of these arcs and the computed lengths, as deduced from the dimensions of the earth given by Captain Clark, of the British Ordnance Survey, shows an almost perfect accordance. It is thus demonstrated that the curvature of the earth is sensibly the same both in the eastern and western hemispheres; or, in other words, we may conclude that the earth is an ellipsoid of revolution, and not an ellipsoid of three unequal axes, as has been maintained by some.—*N. Y. Trib., October* 31, 1873.

THE TOPOGRAPHICAL CHARTS OF SWITZERLAND.

Dr. Wolf, of Zurich, in a short contribution to the history of the magnificent charts of Switzerland, pays a just tribute to Feer, upon whom it seems the first conception of this great work appears to have dawned. The earliest attempts at charting the complicated topography of this region date as far back as 1712, and subsequent editions of the maps, greatly improved, appear to have been published in 1770 and 1802. The latter chart, known as Pfyffer's, seems to have been intrusted to a person by the name of Weiss, who was not wholly competent to the work, but labored faithfully to better the chaotic condition of the older charts. The first application of adequate trigonometric and astronomical methods dates from 1795, when Horner was engaged by Kuster, a rich landowner at Reineck, to prepare an accurate topographical chart of the valley of the Rhine. Feer, who was born at Reineck in 1763, and studied the exact sciences at Zurich, Munich, and Vienna, after visiting numerous observatories in Germany and France, returned to Zurich in 1784, where he soon received

a position as engineer, and where he seems to have pursued astronomical investigations with some assiduity, and even to have established a small observatory. The position of Minister of Finance for Switzerland, which he received in 1806, laid upon him the responsibility of keeping in repair the bridges, roads, and water-ways of the republic, which resulted in the undertaking, in 1809, of a triangulation which extended from the base that he had measured for Kuster in 1797, in the valley of the Rhine, to the Lake of Constance. Finally, to complete the tuition of the young men who should carry on the great work thus begun, he established a bureau for instruction in pure and applied mathematics, at which not only young Switzers, but those from other parts of Europe gathered, among whom may be mentioned Pestalozzi and Steiner. In 1824 Feer died; but the geographical work begun by him is still carried on, although in great part completed and published years ago.

HYPSOMETRY IN THE ROCKY MOUNTAINS.

Mr. J. F. Gardner, geographer to Professor Hayden's survey, in giving a short sketch of the method adopted by him to determine the altitude of the various points occupied by the party in the Rocky Mountains, states that the experience of the surveys of California and of the fortieth parallel show that in the determination of the altitude of any point a mercurial barometer is liable to an error varying from 150 to 300 feet, even when the base barometer is at the foot of the peak, and only 3000 feet below the summit. In connection with Professor Whitney (chief of the California Survey), the following plan was adopted for correcting the errors of barometrical work. Four points were chosen at successive levels of from 1 foot to 14,000 feet. These stations were carefully connected by levelings with a spirit level, and were occupied as permanent meteorological stations. The observations taken by field parties are classified according to their heights, and each class is referred to the base station which is nearest its own elevation; the lower station being Denver, the fourth the summit of Mount Lincoln (14,000 feet), where are a number of silver mines worked by Captain Breese. The central position of this peak admirably fits it for the base of reference. Besides the barometric determination of heights, two

connected systems of trigonometric leveling have been carried over the whole area surveyed, and the check observations are so arranged that the probable error can be easily determined, and it is hoped that the system will prove accurate enough to throw some light on the amount of refraction at great elevations. By these methods the altitudes of many high points have been determined, from which to construct a map in contours 200 vertical feet apart, on a scale of two miles to one inch.—4 *D*, 1873, II., 274.

GEODESY IN THE COLORADO RIVER.

The report of the explorations of Professor Powell in the cañons of the Colorado River impresses one with the very careful manner in which he has attempted to carry out the work undertaken by him. Although only small portable instruments have necessarily been used, it would seem that results of a very high degree of approximation, not to say accuracy, will be attained. To a geodesist the most interesting portion of his report details the method of surveying the district of the Grand Cañon. A base-line was measured with wooden rods leveled on trestles, and aligned by means of a transit-instrument between the extremities of the line. The latitude and longitude of the northern extremity of the base-line were accurately determined. Three rods were used, always remaining in position, as protection against accidental movement. The base-line was found to be 48,100 feet in length, and, starting from its extremities, a system of triangles was expanded so as to embrace all the country immediately inclosing the Colorado River. The angles of these triangles were measured with a seven-inch theodolite. Their sides were often twenty-five to thirty miles long, and occasionally much longer. Six of the more distant points in these triangles were occupied as astronomical stations, and, based on this primary triangulation, a vast net-work of secondary triangles was constructed. The second summer of work in this region was occupied by descending through the cañons in boats, and fixing the course of the river and the topographical features of the walls of the cañon, in which latter work the compass, gradienter, and barometer were in continual requisition. An area of about 45,000 square miles has been already surveyed by Professor Powell's parties, more than

half of this region being accurately and minutely mapped, while in the remaining portion the work is something less accurate, but still far surpasses what is ordinarily known as a preliminary reconnoissance. The plan pursued by Professor Powell, of retaining the Indian names of mountain chains and peaks, whenever those names have been already adopted by the white settlers in their neighborhood, seems to us eminently commendable.—*Powell's Report*, 1873.

GEODESY IN THE FAR WEST.

The Bureau of Engineers, having in charge the geological and geographical explorations and surveys west of the one hundredth meridian, has recently published its first contribution to our accurate knowledge of geographical positions in Wyoming and Colorado Territories. The report, though only relating to two stations—namely, Cheyenne and Colorado Springs—is of particular interest at this time, in view of the consideration by Congress of the important question as to who shall make the surveys of the land. Lieutenant Wheeler, the engineer immediately in charge of the survey, has, we think, very wisely followed the precedent established by the superintendent of the Observatory and the Coast Survey, in giving to the civilians under his direction full credit for the valuable scientific labors that they have undertaken. In the report before us we are favored with the details of the work done by Dr. F. Kampf and J. H. Clark, whose names appear on the title-page as civilian astronomical assistants. The latter presents a memoir on the astronomical operations of the field season of 1872, and the former gives us the results of observations at Colorado Springs in 1873. The general direction and plan of the astronomical work at these stations is laid down by Lieutenant Wheeler with great minuteness of detail, so as to insure the most complete uniformity and the greatest accuracy in the work of each assistant; and at every point we perceive that the assistant in charge of any work is held directly responsible to the public, as well as to his superior officer, for the accuracy of his results. The observations made at the twenty-two remaining primary stations in 1871–73 will appear in the second volume of the reports of the survey, and it would seem that the present publication of the work done at Cheyenne and Colorado Springs is intended to

present to us a specimen of the whole, the stations in question being chosen as typical stations, and "not selected because of probable errors that are a minimum." Without at present critically discussing the accuracy of the observations, or the propriety of certain arithmetical operations, we must conclude by congratulating Lieutenant Wheeler upon the thorough method and the evident desire for the highest attainable accuracy that are manifest in every page of the report; and must express our conviction that if the work undertaken by him be carried on in the spirit in which it appears to have been begun (with only a little less striving after meaningless probable errors of unattainable smallness), he will have earned the lasting gratitude of future generations, who will surely appreciate better than we can, and better than we can foresee, the value to a civilized nation of an accurate map and a reliable census of the contents of all its landed possessions.

MEASUREMENT OF ALTITUDES BY THE BAROMETER.

The employment of the barometer to the measurement of altitudes has long been recognized as one of the most valuable aids to geographical surveys that the physical sciences have as yet afforded; and although for works in which the highest accuracy is desired the barometer must, as has been shown by Rühlmann and many others, be replaced by the engineer's level, yet for common approximate purposes this instrument, in one form or another, must always continue to be employed. Its general usefulness, therefore, increases our interest in the history of its application to hypsometry; and while Rühlmann and others have dealt with this question very extensively, and from a purely physical point of view, it is particularly interesting to notice a memoir, historical rather than mathematical in its nature, that has been presented to the Academy of Turin by no less a person than Professor Govi, who has endeavored to secure for Italy the credit of both the invention and the application of the barometer, since it seems that, while Mariotte did not publish his essay on this subject until 1679, the Torricellian tube had been applied still earlier to hypsometric measures by Montanari. Montanari, a name new to American students, was born at Modena in 1633, and died in 1687 at Padua. Govi claims for him the invention of that most beautiful astronomical instru-

ment, the filar micrometer. In an essay on a brilliant meteor that occurred in 1676, Montanari explains how he measured the altitude of his own station of observation above the sea by the use of the mercurial barometer, then known only by the name of Torricelli; but even this seems not to have been the first time which he applied the instrument to a similar purpose, for, in a letter written in 1671, he speaks of measures made in 1667 upon the summit of Pellegrino, at an altitude of 6500 feet above the Adriatic. The method of computation adopted by Montanari is, if we mistake not, peculiar to himself, and is well worthy of introduction into more modern elementary treatises upon the subject. According to an appendix to Govi's memoir, it seems that Montanari's method subsequently found its way into England, and came to the notice of the illustrious Halley before he had published his barometric formula.—*Atti della R. Accad. Scienze, Turin*, 1873, 587.

DR. TONER'S DICTIONARY OF ELEVATIONS.

Dr. John M. Toner, of Washington, has published a work entitled the "Dictionary of Elevations and Climatic Register of the United States," with the altitude, mean annual temperature, and total annual rain-fall of many localities, and an introductory article on the orographic and other physical peculiarities of North America. This material was collected by Dr. Toner in the course of his researches in reference to the distribution in altitude of certain diseases, especially the yellow fever, and he has rendered a good service in presenting it in a concise form for general reference. The author calls attention to the fact that religion builds by preference on the high places of the earth, and that both in the Old World and the New it is on the loftier summits that we find the temples and shrines of the various peoples. This, it is supposed, may relate somewhat to the fact early impressed upon the notice of mankind, that the inhabitants of lofty elevations are not only nearer to heaven, but also more remote from earthly disease.

Further inquiries in reference to the influence of altitude upon natural productions and upon cultivable crops, as well as upon human health, will be largely facilitated by this unpretending treatise of Dr. Toner, who is very decidedly of the

opinion that for the future improvement in the health of patients will depend more upon visiting and dwelling for a suitable length of time on high altitudes than to any resort to the low lands of the sea-shore, which has hitherto been so much in vogue.

THE THEORY OF THE USES OF THE SURVEYOR'S LEVEL.

Professor Wittstein states that if one imagine a leveling to be conducted along the ocean level from the pole of the earth to some point on the equator, then, in consequence of the method according to which the level is ordinarily used, the value of the difference in altitude of the two ends of the given line would be exactly zero. To this Helmert adds that the conclusion can only be correct when we neglect the unequal curvature of the various points of the level surface as we proceed from the pole to the equator, since Wittstein's conclusion certainly involves the assumption that the level or horizontal plane is tangent to a perfectly spherical surface. Oudemans, of Batavia, has taken up the question at this point, and investigates the amount of the accumulated error that would result from the assumption which Helmert has correctly shown to be involved in Wittstein's statement. He concludes that, if the average distance between two successive stations in the course of the leveling operation be 600 feet, then the sum of all the possible errors arising from this source will amount to only one five-thousandth part of an inch in the entire quadrant of the earth's circumference, but will amount to three feet if the average distance between the successive stations be so great as twenty miles. In either case the error would be inappreciable in comparison with those arising from other causes.—*Astron. Nachrichten*, LXXXIII., 23.

SAILING DIRECTIONS FOR ATLANTIC NAVIGATION.

No. 45 of the publications of the United States Hydrographic Office, of the Bureau of Navigation, is an elaborate memoir on the navigation of the Atlantic Ocean, translated by Lieutenant-Commander Coghlan from the French of Mons. F. Labrosse. The volume is devoted, first, to a general account of the calms, winds, currents, icebergs, and barometric pressures; and, second, to the different routes from various parts of the world to other portions of these coasts; and is

divided into two sections—one on the North Atlantic, and the other the South. This volume is a fit accompaniment to one previously noted, constituting a coast pilot to a portion of the shores of Brazil.—*No.* 45, *Rep. of Hydrographic Office.*

LONGITUDES OF WASHINGTON AND GREENWICH.

On the recent occasion of the determination of the longitude between Washington and Greenwich it was found convenient to employ an intermediate point located on the French coast, and the opportunity was improved by Mr. Hilgard, of the Coast Survey, to make a new determination of the difference in longitude between Paris and Greenwich. The interest which attaches to a determination between the two oldest observatories of Europe by the astronomers of the New World increases when we learn that the result of this latest determination of longitude varies very little from that made by the European astronomers in 1863, but differs widely from that which has hitherto been adopted as the correct longitude.—*Proc. Amer. Assoc.*, *N. Y. Trib.*, *October* 31, 1873.

LONGITUDES AT SEA.

The accuracy of the determination of longitude at sea by the employment of chronometers forms the subject of an interesting communication from De Magnac—a subject that has also attracted much attention in connection with the loss of several valuable vessels with precious human freight. De Magnac states that of all the physical causes acting at sea upon the chronometers, the principal are the atmosphere and the time. The construction of chronometers has been carried to so high a degree of perfection that the function which represents the daily rate of the chronometer is almost always a continuous function of the above-mentioned data; but it is still uncertain whether we can rely upon absolute immunity from some sudden change in the rate of any one chronometer. Therefore it would be highly unsafe to rely in a long voyage upon an isolated chronometer; and neither can we study the action of the disturbing causes unless several of these instruments are carried upon the same vessel. The author has, therefore, during the years 1871–73, observed with accuracy all the chronometers upon the vessel *Jean Bart* in its voy-

ages across the Atlantic, in both the northern and southern hemispheres. A careful study of these instruments has enabled him to determine their rates at sea with such precision that the longitudes of points on the western coast of the Atlantic, especially in South America, deduced from the separate voyages of the *Jean Bart*, agree within a few seconds among themselves, and equally well with the longitudes determined by what are considered more accurate methods, and published in the French Nautical Almanac. He shows, in fact, that even in voyages lasting two months the navigator should be able to determine his longitude at sea to within three seconds of time when employing four chronometers.—6 *B*, 1873, 611.

FLUCTUATIONS IN THE LEVEL OF LAKE SUPERIOR.

Professor Whittlesey has given a paper on the fluctuation of the level of Lake Superior—a subject specially studied by him many years ago, and which has as yet received but slight elucidation. In his present communication he has confined himself to the consideration of those fluctuations which are not only transient, but also occurring with the regularity of a wave—those low pendulum-like pulsations which are probably common to all the lakes, but are most noticeable in Lake Superior. Until a better theory can be found, he adopts the explanation that these undulations are caused by atmospheric movements.—*Proc. Amer. Assoc.*, *N. Y. Trib.*, *October* 31, 1873.

EXPLORATION OF LAKE OKEECHOBEE.

In the number of *Forest and Stream* for April 6 is published a letter from Mr. Frederick Ober, under date of March 18, announcing the result of an exploration of Lake Okeechobee, a very little-known body of water in South Florida, around which a halo of romance has been thrown, in consequence of mysterious references to ancient ruins of vast extent, and wonderful forms of animal life, such as spiders weighing several pounds, etc. As might have been expected, however, from a knowledge of the surrounding regions, no such objects were met with, and the ruined cities proved equally to be myths.

Mr. Ober reports that the only practicable route to Lake Okeechobee is that *via* Kissimmee River, which is descended

until the lake is reached. This proves to be about forty miles long and twenty-five broad. It is very shallow, nowhere showing a greater depth than twelve feet, while shallows extend for miles into the lake. Very few fish were found, and even alligators were scarce. Birds, with the exception of the fish-hawk, courlan, snake-bird, and herons of various species, were not seen.—*Forest and Stream, April* 6, 1874, 145.

EXPLORATIONS OF PINART IN ALASKA.

The December *Bulletin* of the Geographical Society of Paris contains an account by M. Alphonse Pinart of his explorations of Alaska, prosecuted in 1871, with a map showing the region of his travels. These embraced a considerable part of the island of Kodiak, the southern portion of the Aleutian Islands, of Unalashka, Unamak, and Oomnak, as also Bristol Bay and Norton Sound, and Plover Bay, on the Siberian coast. A great amount of interesting information is given in regard to tribes visited, and the geographical peculiarities of the country, the latter including original determinations of the altitude of several mountains, the discovery of a bay on the south side of Alaska (now called Pinart Bay), which was previously unknown; statistics of the Esquimau and Aleut population, etc. Numerous collections in ethnology and geology were made by M. Pinart, and a large number of photographic views of scenery taken, and many portraits secured.

Several communications upon the geological and paleontological collections of M. Pinart had been already made by French savans.—*Bull. Soc. Geogr., Paris, Dec.*, 1873, 561.

EXPLORATIONS OF W. M. GABB IN COSTA RICA.

Few persons are aware of the important exploration which has been going on for a year or two past in Costa Rica under the direction of Professor William M. Gabb, a geologist and explorer of Philadelphia, well known for his excellent scientific work, especially in connection with the Geological Survey of California under Professor Whitney.

The special object is an investigation of an entirely unknown region of Southeastern Costa Rica, inhabited only by savages, but known to contain rich treasures of minerals,

worked by the Spaniards in the early days of the Conquest, this knowledge being only by traditions. The expenses are borne conjointly by the Costa Rican government and by the contractors for the Costa Rica Railroad; and although the party has consisted only of Professor Gabb and four assistants, it has already gathered a great deal of important information and material in reference to the economical, scientific, and political history of the region investigated.

In the course of his labors, Professor Gabb found the people less savage than had been supposed, and he has already succeeded in winning their confidence to such an extent as to induce their chief to accompany him on a visit to San José.

As might have been expected, the geological structure of the country has occupied a large share of Professor Gabb's attention, and enough has been discovered to warrant the belief that the mineral resources are of great importance. The greatest interest attaches, however, to the discovery of two previously unknown volcanoes, not less than 7000 feet high, in the main Cordillera just northwest of Pico Blanco. Of these he is about making a thorough examination. The natural-history collections made by the Professor are of unusual magnitude and value, embracing all departments of zoology, and especially rich in mammals, birds, reptiles, and insects. Of fish there were but few species, but all that could be found were secured. The ethnology and philology of the country have been attended to very thoroughly, and vocabularies, amounting in some cases to five hundred words, of certain divisions of the tribe, have been made. Material illustrating the manners and customs of the people was also gathered in great quantities, and important discoveries made of *Huacos*, or prehistoric graves.

In addition to these, Professor Gabb is on the track of an ancient buried city, of which no mention is made in any history of the country. The natural-history and ethnological collections made have been sent to the National Museum, where they form a conspicuous feature in the Central American series.

The material thus collected by Professor Gabb will, on his return, be made the subject of an elaborate work, in which he hopes to present the whole subject of the physical and

natural history of the country in its fullest detail. An important geological discovery made by him is that the appearance of dry land on the Isthmus is of tertiary date, and that it is coeval with the period of volcanic excitement in the California sierra.

PROFESSOR ORTON'S EXPLORATIONS.

Professor Orton has returned to the duties of his chair at Vassar College, after a very interesting and successful expedition to South America. His general route was up the Amazon to Yurimaguas, on the Huallaga, by steamer, thence by canoe up the Parana-pura to Balsa-Puerto, thence on foot over the mountains, *via* Moyobamba, to Chachapoyas, and thence by mule, *via* Balsas and Cajamarca, to Pascamayo, on the Pacific. Descending along the coast (or, in the local phrase, ascending), he visited Lima, and afterward Mollendo (south latitude, 17°). He then proceeded, *via* Arequipa, to Lake Titicaca, being the first traveler to go from the Pacific to that lofty lake by the railroad just completed. His principal object was the study of the physical geography of the Marañon and its tributaries; and he succeeded in securing a large amount of information throwing light on that interesting region, hitherto visited mainly by collectors, and in obtaining data for a very accurate map of the entire Montaña, shortly to be constructed.

Numerous collections were made by Professor Orton along his route, to illustrate the geology and the distribution of life. A very prolific bed of fossil shells was found at Iquitos, in the same "Tabatinga clay formation" in which he had discovered them at Pebas in 1867, but with additional species. He also collected brachiopods and ammonites on the Andes. His most important collections, however, consisted of fishes, reptiles, and shells from the Marañon and the Andes. The cold-blooded vertebrates collected by Professor Orton have been placed in the hands of Professor Cope for identification.

Professor Orton also made some archæological investigations in several localities, and brought home with him a rich assortment of mummies, skulls, earthen and copper utensils, and textile fabrics. The round burial towers which he visited at Sillustani he considers as doubtless pre-incarial.

RECENT EXPLORATIONS IN NEW GUINEA.

A summary of the more recent labors in regard to the exploration of New Guinea has lately been published, in *Nature*, by Mr. Adolph Bernhard Meyer, himself distinguished in this connection. In this he states that, in 1871, a steamer was sent out by the Dutch to circumnavigate the island, and to take possession of that portion of the country which did not already belong to them. This failed to accomplish its object, a few posts only being established on the north coast, when the vessel was obliged to return without having performed its task.

A second expedition was sent out in 1872, which accomplished less than the first. It is, however, proposed to send out an expedition in 1874. In 1870 some Italians, under the guidance of M. Cerruti, visited the southwest coast, for the purpose of exploring the strait between the island of Salwatty and the mainland. They were, however, attacked and beaten off by the natives in McCluer Gulf. In 1872 two Italian naturalists, M. Beccari and M. D'Albertis, endeavored to visit the place, on the southwest coast, called Utanate, but failed, on account of currents and winds. They remained for some time at Sorong, and thence proceeded to Dorey, in the north, and made a station on the Arfak Mountains. They returned in 1872, an Italian vessel of war having been sent after them.

They brought back numerous interesting collections in natural history, embracing large numbers of birds-of-paradise and parrots. About the same time Mr. Michlucho Maclay, to whom reference has been made in our pages, spent a season at Astrolabe Bay. Mr. Meyer himself has been among the most prominent explorers of this region, having proceeded from Ternate, early in the year 1873, to the harbor of Dorey, in the northwest corner of Geelvink's Bay, from which place he went to Mafood, about sixty miles from Dorey. After examining this locality, he crossed to the island of Mysore, where he spent considerable time, and procured many interesting collections. No birds-of-paradise were found on the island; and on the island of Jobie, believed to contain many species, he found but three kinds. From this point he crossed inland into McCluer Gulf, and thence to a river

called the Jakati, and succeeded in obtaining, at altitudes of from three to six thousand feet, all the known birds-of-paradise of New Guinea, together with one hitherto undescribed. —12 *A*, *December* 4, 1873, 79.

DISCOVERIES OF ABBÉ DAVID IN MAUPIN, CHINA.

Much interest has been excited among zoologists by the remarkable discoveries made within the past few years, by the Abbé David, in the district of Maupin, a portion of China in the "Yungling Mountains," which separate China proper from Thibet. His labors have been continued from 1868 to the present time, and the results have been published by the professors in the Museum of Natural History in Paris in their well-known *Archives*. The region itself is not very extensive, although characterized by a great variety of altitudes, which range from seven to fifteen thousand feet above the level of the sea. No less than one hundred and ten species of mammals were collected in ten months' residence by the Abbé David, of which about forty were new to science, and some of them of a most remarkable character. Among these may be especially mentioned a new species of monkey, covered with dense hair, and having a turned-up nose, which inhabits the highest forests, adjoining the snow. The existence of two or three other species of monkey was also ascertained.

Among the insectivora were many new species of some types and new genera, others belonging to those already known.—12 *A*, *May* 14, 1874, 32.

GEODESY IN THE ISLAND OF CORSICA.

Perrier, who has recently had charge of the new geodetical survey of the island of Corsica, states that in the former work by Durand, in 1827, an attempt was made to connect, by triangles having sides of the enormous length of 122 and 167 miles, the position of this island with the geodetical points on the mainland. In his late attempt to revise this work, having found that the signals established by Tranchot had mostly disappeared, and that many topographical points could not be recovered with certainty, he has judged it necessary to execute an entirely new triangulation of the island, and has prepared a chart on the scale of $\frac{1}{80,000}$, in which, by contour lines, he represents geometrically every feature in

the relief of the soil. The probable error of the angles observed by himself is 3½ seconds, while the error of the triangles observed by Tranchot is 10 seconds. The primary triangulation conducted by Perrier includes 67 stations, extending over an arc of 5° in latitude. Levelings have been conducted throughout the whole island. The discordances between the levelings that have been independently conducted up to the principal points are generally small, and never exceed 10 feet, even for differences of level as great as 8000 feet.—6 *B*, LXXVIII., 1570.

ERRORS IN TRIGONOMETRICAL LEVELINGS.

Baeyer has published a thorough investigation into the question of the influence of local deviations of the plumb-line upon the accuracy of leveling operations. These local deviations, as is well known, exist in all parts of the earth, and are generally specially notable in mountainous countries—at times amounting to a large angle, so that the plumb-line can no longer be considered as truly vertical; and their origin, although not always definitely known, is yet probably always to be attributed to the attraction of mountains, the absence of attraction in the case of cavities within the earth, and to the sometimes greater density of the strata underneath the ocean. Having deduced a general mathematical formula applicable to all cases, Baeyer concludes that a leveling is not strictly reliable unless it has been proved either that no local deviations of the plumb-line exist, or unless the existing deviations have been properly allowed for by the formula given by him. In applying this formula to a special case of accurate measurements in Germany, Baeyer shows that, in a horizontal distance of about eight miles, and a vertical altitude of one thousand feet, an error of half a foot is involved; and that again, in another instance, in a distance of nine miles, and a vertical altitude of fifteen hundred feet, an error of eight tenths of a foot is to be attributed to the effects of local deviations. The result of this investigation will be to fix more definitely the standard sea level to be adopted by all nations as the reference plane to which to refer their geodetic measurements. Applying Baeyer's formula approximately to what may be assumed to be the deviations of the plumb-line in the interior of the American continent,

we shall find that the error of a line of levels running from St. Louis to Denver, or New York to Cheyenne, amounts to many feet.—*Astron. Nach.*, LXXXIV., 1.

THE ARCTIC CONTINENT AND POLAR SEA.

Nature gives the following summary of a paper by Dr. Joseph Chavanne, of Vienna, on "The Arctic Continent and Polar Sea," as published in Petermann's *Mittheilungen* for July 7: 1. The long axis of the arctic land-mass (which probably consists of an island archipelago separated by narrow arms of the sea, perhaps only fiords) crosses the mathematical pole; it thus bends round Greenland, north of Shannon Island, not toward the northwest, but runs across to 82° or 83° N. lat. in a northerly direction, proceeding thence toward N.N.E. or N.E. 2. The coast of this arctic continent is consequently to be found between 25° and 170° E. long. in a mean N. lat. of 84° and 85°, the west coast between 90° and 170° W. long. in a latitude from 86° to 80°. 3. Robeson Channel, which widens suddenly north of 82° 16′ N. lat., still widening, bends sharply in 84° N. lat. to the west; Smith Sound, therefore, is freely and continuously connected with Behring Strait. Grinnell Land is an island which probably extends to 95° W. long., south of which the Parry Islands fill up the sea west of Jones's Sound. 4. The sea between the coast of the arctic polar land and the north coast of America is traversed by an arm of the warm drift current of the Kuro Siwo, which pierces Behring Strait, and thus at certain times and in certain places is free of ice, allowing the warm current to reach Smith Sound. 5. The Gulf Stream, gliding between Bear Island and Novaya Zemlya to the northeast, washes the north coast of the Asiatic continent, and is united east of the New Siberia Islands with the west arm of the drift current of the Kuro Siwo. On the other hand, the arm of the Gulf Stream which proceeds from the west coast of Spitzbergen to the north, dips, north of the Seven Islands, under the polar current, comes again to the surface in a higher latitude, and washes the coast of the arctic polar land, the climate of which, therefore, is under the influence of a temporarily open polar sea; hence both the formation of perpetual ice, as well as excessive extreme of cold, is manifestly impossible. 6. The mean elevation of the polar land

above the sea diminishes toward the pole. 7. The sea between Spitzbergen and Novaya Zemlya to Behring Strait is even in winter sometimes free of ice, and may be navigated in summer and autumn. 8. The most likely routes to the pole are, first, the sea between Spitzbergen and Novaya Zemlya; and, second, the sea north of Behring Strait along the coast of the unknown polar land.—17 *C*, *July* 7, 1874.

EXPLORATION OF NORWEGIAN SEAS.

Professor Mohn and Mr. G. O. Sars, of Christiania, are preparing a plan for the investigation of the sea between Norway, the Faroe Islands, Iceland, and Spitzbergen, the expense of which, it is expected, will be defrayed by a grant of the Norwegian Storthing. *Ocean Highways* commends this very highly as supplementing the labors of the *Challenger*. The researches are to be prosecuted in an important region, and with the best form of apparatus.—6 *A*, *November*, 1873, 340.

GERMAN SOCIETY FOR POLAR EXPLORATION.

The German Society for Polar Exploration has, it is said, purchased the harbor of Kristvig, on the island of Averio, on the west coast of Norway, with the intention of making this in future the starting-point of German explorations of the arctic regions.—13 *A*, *March*, 1874, 313.

ARCTIC EXPLORATION IN ENGLAND.

The friends of arctic exploration in England were disappointed in their hope to induce the British Government to send out an expedition during the year 1874, but are still sanguine that this object will be attained and carried out on a very large scale in 1875. Deputations were in readiness on the part of the Royal Society, the Royal Geographical Society, the British Association, and the Dundee Chamber of Commerce, to present memorials to the government; but an interview was declined, on the ground that the subject could not be suitably considered at the present time.

The excuse was made that the operations of the *Challenger*, in the survey of regions of commercial importance, have exhausted all the available resources of the government in this direction, and that, until the period of the return of this ship,

it will be inexpedient to consider the question of any additional labor.

Ocean Highways, for February, contains the correspondence between Gladstone and Sir Bartle Frere on this subject; and in a letter of the latter gentleman we find that the cost of the work, on a large scale, is estimated at about £25,000 sterling per annum. He remarks that should the government decline to take the entire charge of the work, it will probably be called upon to assist a private expedition, which, however, he thinks much less desirable. An accompanying communication from the Dundee Chamber of Commerce presented, as the principal argument in favor of this expedition, the unknown seas and coasts north of Greenland, and the great probability of finding out new localities for whale fisheries, in view of the large increase in demand for animal oil, of which fully three thousand tons are required at Dundee in the manufacture of jute alone. The experiences of the *Polaris* party do not promise much in this direction, as no whales whatever were observed inside of Robeson Channel; neither were any fishes seen, excepting a few young salmon.—6 *A, February*, 1874, 466.

OPERATIONS OF THE "CHALLENGER" FOR 1874, 1875, 1876.

The programme of the *Challenger*, in the way of future explorations after leaving Simon's Bay, South Africa, is as follows: Dredgings and temperature soundings are first to be made on Agulhas Bank, and Marion Island and the Crozets are then to be examined, the latter work with special reference to its occupation by the French as an observing station of the coming transit of Venus. Kerguelen's Land is next to be visited for the same purpose, and an exhaustive survey will be made for the benefit of such of the American and English parties as intend to visit it during the transit. The longitude of the island is to be determined very accurately by means of chronometrical measurement from the Cape, and again to Melbourne.

Macdonald Island will next be touched at, with a view of finding a harbor there, and likewise with reference to the transit of Venus expedition, after which the vessel will pass on to the Ice Barrier; thence sail will be made to Melbourne, to be reached by the end of March, and after examining the

region a few days the vessel will proceed to Sydney, and, if necessary, dock there.

Leaving Sydney about the middle of May, 1874, a line of soundings will be made to New Zealand, and the Coral Sea and Torres Strait, etc., will be examined in August; while New Caledonia, New Guinea, Arofura Sea, Kaepang in Timor, Java Sea, Macassar, Celebes, and Manilla will, it is expected, be successively visited by November. Then the doubtful islands of the South Pacific will be looked up, New Ireland and the Solomon and Pelew Islands visited, reaching Japan in March, 1875. From Japan the passage will be made across to Vancouver's Island, thence to Valparaiso, which will be left in the end of 1875; and, passing through the Strait of Magellan to the Falkland Isles, the route will be by way of Rio Janeiro and Ascension to England, by the middle of 1876.—12 *A*, *February* 19, 1874, 304.

NOTES OF THE "CHALLENGER" MOVEMENTS.

An important communication has lately been made by Professor Wyville Thomson, chief of the scientific force of the *Challenger*, to Admiral Richards, of the British Hydrographic Service. This was written from Melbourne on the 17th of March, and contains later details in regard to the discoveries of the *Challenger* than had heretofore been announced. After leaving the Cape of Good Hope, about Christmas-time, nineteen principal stations had been visited up to the time of writing, including Marion Island, the neighborhood of the Crozets, Kerguelen Land, and the Heard group. The dredgings made just after leaving the Cape revealed an abundance of animal life, with the interesting fact that the general character of the fauna was very similar to that of the North Atlantic, many of the species even being identical with those on the coast of Great Britain and Norway.

The use of the trawl at a depth of 1600 fathoms, between Prince Edward's Island and the Crozets, yielded a large number of marine objects. Among them were the sponges *Euplectella* and *Hyalonema*, and two entirely new genera of stalked crinoids, some remarkable crustaceans, etc. Off Christmas Harbor, in Kerguelen Land, the trawl brought up large cup sponges of the genus *Rossella*.

The most southern station was made on the 14th of Feb-

ruary, in latitude 65° 42′ S., longitude 79° 49′ E. Here, at the depth of 1675 fathoms, the trawl brought up the usual variety of animals. A large number of the species collected were entirely new to science.

The most striking result obtained during this section of the expedition was the discovery that, whenever the sea bottom contained globigerina ooze and the red clay produced by the decomposition of foraminifera shells, there the seas above it abounded in living *globigerinæ*, *pulvinulinæ*, and *orbulinæ*, as shown by the use of the towing-net down to 150 fathoms. Professor Thomson was therefore led to the conclusion, quite contrary to a previous impression, that the bulk of the materials at the bottom is in all cases derived from the surface. He, however, admits the existence of other forms of foraminifera as living organisms in the bottom mud, but in comparatively small numbers. He further remarks that the difference between the living and free-floating *globigerinæ* and their shells at the bottom is so great as to add to the certainty that the latter are dead, although frequently containing organic matter.

A serious inconvenience experienced during these researches in the antarctic regions was the severity of the weather, the instruments becoming so cold that it was unpleasant to handle them, and the vapor of the breath condensing and freezing at once upon the glass and brass work.

As the result of the investigations relative to the percentage of carbonic acid in the water, it was found that the smallest amount occurred at the surface of the water near Kerguelen Land, and the largest amount was found in the bottom water close to the antarctic ice.—12 *A*, *June* 25, 1874, 142.

HORETZKY ON THE HUDSON'S BAY TERRITORY.

A memoir by Mr. Charles Horetzky, on the country northwest of Canada, contains a sketch of a portion of the great region recently under the control of the Hudson's Bay Company, and has special reference to the route of the Canadian Pacific Railway. Mr. Horetzky is of the opinion that the region surveyed is eminently suited to the construction of this great enterprise, and that the grades and the climate are such as to furnish a very favorable comparison with any lines within the United States.

PROFESSOR STODDARD'S EXPEDITION TO COLORADO.

Quite an extensive expedition has been going on in Colorado during the past summer, under the direction of Professor O. N. Stoddard, of Wooster University, having for its object the collection of specimens for that institution and for some others, the representatives of which were in the party. The collections consisted principally of minerals, especially the gold and silver ores of the country, as well as various rocks and fossil remains. Professor Boyd, the botanist of the expedition, obtained between six and seven hundred species of plants, while Professor S. L. Bell, the zoologist, gathered a corresponding collection of animals.

SALTNESS OF THE WATER OF THE SUEZ CANAL.

According to a recent investigation, the sea-water found in different parts of the Suez Canal has proved to be excessively salt as compared with that of the Mediterranean. Thus while the latter leaves, on evaporation, about forty kilos of salt matter per cubic meter, the canal yields seventy-five kilos. It is supposed that this excess is derived from the dissolving of salt in the beds along the banks of the Bitter River. At Port Said, where the water is freshened by the Nile, it does not yield a residue of more than twenty-five kilos to the cubic meter. It would be an interesting question to determine whether any fish, and, if any, what species, inhabit the most salt portions of the canal.—15 *A*, *August* 8, 1874, 182.

GOVERNMENT EXPLORATIONS IN PARAGUAY.

The Paraguayan government has authorized an exploration of its territory and resources, and for the purpose has appointed a commission consisting of Mr. Charles Twite, geologist, Mr. Balzana, botanist, and Mr. Keith Johnston, geographer. Their first report is expected by October, 1874.—6 *A*, *November*, 1873, 340.

EXPLORATION OF TERRA DEL FUEGO.

An exploration of Terra del Fuego has recently been prosecuted by Mr. Pertuiset, in behalf of the Chilian government. He and his party started from the vicinity of Arenas,

in the Strait of Magellan, and proceeded to the western end of the channel of Grand Bay. They then traversed the island in a northwesterly direction, and went southward to Useless Bay, embarking at the latter place, on the 18th of January, on the Chilian frigate *Abato*, for Valparaiso. According to Pertuiset, the island, geologically speaking, is of but little interest. He found it, however, well adapted to the cultivation of cattle, on account of the rich grassy vegetation, there being room for the rearing of hundreds of thousands of these animals.

Mr. Pertuiset writes also that he found oats and rye growing luxuriantly in various localities. The flora is similar to that of Southern Patagonia; very few woody plants, however, were met with.

The natives were very shy, and scarcely to be seen by the travelers, but seemed to be superior to the Patagonians. Their clothing consisted of skins, and their food of fish, rats, eggs of wild ducks, etc.—17 *C*, VI., 232.

EXPLORATIONS IN RODRIGUEZ.

The establishment of a station in the island of Rodriguez for the observation of the transit of Venus is to be utilized by the British expedition for the prosecution of researches into the extinct birds of the island. *Nature* remarks that, as a general rule, oceanic islands lying at a great distance from the continents are volcanic in their origin, and that the Seychelles and Rodriguez are almost the only exceptions to the rule, the latter island being composed, it is said, of granite overlaid with limestone and other recent rocks. A rich field of research for the discovery of extinct animals is therefore expected. Already a complete skeleton of *Pezophaps solitaria*, a bird allied to the dodo, has been obtained from a cave in the limestone rocks, and ample material in regard to other species is believed to be extant on the island.

Kerguelen's Land, also, an island one hundred miles long and fifty broad, although containing very few land plants, is thought likely to yield a rich harvest in animal forms, certainly recent, if not fossil. Very little is known of it, and much is expected as the result of careful examination.

Nature concludes by expressing the opinion that it will be difficult to find two spots on the earth's surface where biolog-

ical research is more likely to lead to satisfactory results than is the case of those just mentioned.—12 *A*, *Dec.* 18, 1873, 117.

EXPLORATIONS BY THE RUSSIAN GOVERNMENT.

The organization of an expedition to the Amu-Darya has been finally decided upon by the Imperial Geographical Society of St. Petersburg. This is to be under the command of his imperial highness the Grand Duke Nicolas and of Colonel Stolotow. It will consist of twenty-six persons, and will be divided into four sections: namely, geodesy and topography, meteorology, ethnography and statistics, and natural history. It is also stated that a second expedition, to which the government has made a grant of ten thousand rubles, will have for its mission the determining of the geodesy of the region between the Caspian Sea and Lake Aral. A third expedition, already referred to, under Middendorf, has for its object the exploration of the Ustjast, of the delta of the Amoor, and of the ancient course of the Oxus.

In the same connection it may be stated that, at the request of the society, the Russian government proposes shortly to enter upon a complete scientific exploration and survey of the whole of Siberia, the nominal object being the acquisition of information looking toward the construction of various lines of railways.—3 *B*, *August* 6, 1874, 530.

ROHLFS' EXPLORATION OF THE LIBYAN DESERT.

The exploration of the Libyan Desert, under Gerard Rohlfs, has been completed, and on the 17th of April the intrepid commander presented a narrative of his adventures to the Egyptian Institute at Cairo. The great object of the expedition, the oasis of Kufarah, was not reached, as they were impeded by an interminable chain of sand-hills, which the high winds kept shifting so as greatly to endanger their lives. As it was, they lost sixty camels. They then turned toward the north, and after touching at the great oasis of Dachel they passed on to that of Siwah, farther to the west. A large number of photographs were obtained, showing, among others, the beautiful temple in the oasis of Dachel, with wonderfully preserved hieroglyphics. — 13 *A*, *May* 16, 1874, 545.

PHYSICAL CONDITION OF THE LIBYAN DESERT.

Dr. Zittel, of Rohlfs' Libyan expedition, describes the results of the undertaking as of much scientific interest, even though their practical value is not so great as was hoped. One conclusion arrived at is that the Libyan Desert is the most sterile and barren part of the entire Sahara; as also that the irrigation and colonization of the true desert are alike impossible, and that the permanent occupation of the oases is not practicable, on account of their isolated position. Determinations of the degree of humidity and the quantity of ozone in the atmosphere were made with great regularity. Minute researches were prosecuted in regard to the flora and fauna and the geology of the region. In the last branch it was ascertained that the desert, instead of having one uniform cover of nummulites, lime, and sand, was found to consist of cretaceous, eocene, and miocene formations, with an abundance of well-preserved fossil remains. Numerous photographs of the scenery, animals, etc., were taken on the expedition.—13 *A*, *May* 3, 1874, 603.

RUSSIAN EXPLORATION IN LAPLAND.

The *Academy* finds in the correspondence of a Russian traveler the announcement of the intention of the Russian government to dispatch two scientific expeditions: one to the Keme district and to Russian Lapland, with the object of making a study of the geology of the region and examining the traces of ancient glaciers; and the other to the shores of the White Sea, for the purpose of prosecuting zoological researches. Much interest attaches to these operations, for Dr. Yazkinsky, who for the last two years has been at work in these parts, has discovered a great many specimens of fish and crustaceans of an entirely new character.—13 *A*, *May* 3, 1374, 604.

EXPLORATIONS OF MR. J. B. STEERE IN CHINA.

According to the *China Mail*, as quoted by the *Academy*, Mr. J. B. Steere, an American, who has been traveling in the East for the purpose of collecting specimens for the Michigan University, has just returned to Hong-Kong from a trip through Formosa. He spent six months in the interior of

the island, principally among the wild tribes. He reports his collections as very extensive, including thirty-five species of serpents. He has also found a number of ancient manuscripts, and succeeded in preparing a vocabulary of five different dialects, proving conclusively that the language spoken by these people is essentially Malayan, and stands in nearest relation to the dialects spoken in the Philippines.—13 *A*, *May* 23, 1874, 574.

THE CHINESE RIVER HANG-KI-ANG.

According to the Abbé David, the Chinese river Hang-ki-ang, until lately almost unknown, is an important river of commerce, traversed by vessels of every size. A considerable portion, however, is difficult of navigation, owing to the existence of numerous rapids and many rocks.—13 *A*, *February* 21, 1874, 201.

THE SOURCES OF THE IRRAWADDY.

Among the problems of geographical science still remaining unsolved is that regarding the sources of the Irrawaddy, the great river of Burmah; and it was announced at the recent meeting of the French Scientific Association that the emperor of the country had recently fitted out an expedition for the purpose of settling the question.—8 *B*, *August* 29, 1874, 202.

AN IMPROVED LARGE THEODOLITE.

Oertling, of Berlin, gives an interesting description of the fine theodolite constructed by him for the use of the United States Engineers' Survey of the great lakes. He states that in the summer of 1866 he received the order through a Boston house to construct, for the Engineer corps at Detroit, three large theodolites, which were to be used on the great survey of the North American lakes. These three theodolites were precisely alike, and were finished, according to the plans given him, in the very short time of fourteen months. Their construction differs in many important details from other instruments of the same class. So far as known to him, he states that as yet no portable instruments having divided circles of twenty-one and a half inches in diameter, and telescopes thirty-four inches' focal length, have been made or

used. He has furnished the instruments made by him with three micrometer microscopes for reading the divisions of the circle. The telescopes were provided with Kellner's oculars, and the axis constructed of hard aluminium bronze. The instruments were intended to be used for astronomical as well as geodetic purposes. Borda's principle of repetition was not introduced. The divisions of the circle were cut by an instrument which is his own property, and itself constructed by him. This circle-dividing machine has a diameter of over two feet. It does the dividing, and at the same time corrects its own errors, and is therefore a self-acting and self-correcting dividing-engine. It is evident that this dividing-machine will be of great importance to German instrument-makers, from the fact that the dividing-machine constructed for the state, at the instance of Alexander von Humboldt, in the reign of Frederick William IV., and which was officially delivered in 1867, seems to have disappeared; at least no information can be obtained concerning it.—*Carl's Repertorium*, X., 50.

EXPLORATIONS OF PROFESSOR POWELL IN 1874.

During the past season the field force under Professor Powell, who has had charge of the Second Division of the Geological and Geographical Survey of the Territories, has been divided into two parties. The larger, under Professor Thompson, has been at work in Middle and Southeastern Utah along the Sevier River and the country to the east, nearly to the Colorado. The other party, with Professor Powell, has been carrying forward the work in a region of country west of the Sanpete River in Northeastern Utah.

The geographical survey has been extended by the expansion of a system of triangles from a base-line previously established at Gunnison, making this the base of topographic work. For hypsometric purposes Green River City, on the Union Pacific Railroad, Salt Lake City, Gunnison, and Pangwitch have been used as stations for base barometers; the altitude of these points had been previously determined by railroad surveys. The assistants in the topographic work were Professor H. C. De Motte, of the Illinois Western University, and Messrs. Renshaw, Graves, Forbes, and Wheeler. These gentlemen, with the exception of the last two, had

been previously employed in the undertaking. Mr. Howell has assisted Professor Powell in the geological work.

During the season extensive regions of volcanic rocks on either side of the Sevier, and on the eastern side of the Wasatch and Aquarius plateaus, have been surveyed, with interesting results. The great system of monoclinal faults and folds extending in a northerly and southerly direction across the Grand Cañon of the Colorado, and north into the region of this summer's work, which had been previously discovered, has been more thoroughly studied, and other groups of displacements, having a more easterly and westerly trend, have been found and carefully examined.

In addition to the geographical and geological work, much has been done in ethnography, especially among the U-in-tats and Seu-ra-rits, and large collections illustrating the state of arts among them have been made. Much additional matter in relation to their language, mythology, customs, and habits has been obtained. An interesting series of facts concerning their method of giving names to tribes and confederacies has been found. It seems that each tribe or primary organization of Indians, rarely including more than two hundred souls, is, in obedience to the tradition laws of these people, attached to some well-defined territory or district, and the tribe takes the name of such district. Thus the U-in-tats, known to white men as a branch of the Utes, belonged to the Uintah Valley. *U-imp* is the name for pine; *too-meap*, for land or country; *U-im-too-meap*, pine land; but this has been contracted into *U-in-tah*, and the tribe inhabiting the valley are called U-in-tats.

The origin of the term Ute is as follows: *U* is the term signifying arrow; *U-too-meap*, arrow land. The region of country bordering on Utah Lake is called *U-too-meap* because of the great number of reeds growing there, from which their arrow-shafts were made. The tribe formerly inhabiting Utah Valley was called U-tah-ats, which has been corrupted into the name Ute by the white people of the country; the name U-tah-ats belonged only to a small tribe living in the vicinity of the lake, but it has been extended so as to include the greater part of the Indians of Utah and Colorado.

For offensive and defensive purposes it often happens that

two or more tribes are united in a confederacy. This is usually a very loose organization, and is constantly changing. One of the influential chiefs of the tribes is recognized to a greater or less extent as the chief of the confederacy. Such a confederacy often takes the name of the principal chief; sometimes it takes the name of the principal tribe, or, again, it will take the name of some important event which has led to the organization of the confederacy.

Another class of names originate in this way: A great many tribes in Utah, Nevada, and Northern Arizona are known to white men as Pah-Utes or Pi-Utes. The origin of this name is as follows: A long time ago, as the Indians express it, there was a tribe of Indians living about Utah Lake known as U-tah-ats. Another, known as Tim-pa-no-ga-tsits, living on the Timpanogas, a Provo river, made war upon them, drove them away, occupied their country about Utah Lake, and called themselves U-tah-ats. The defeated Indians moved farther to the south, and settled on the stream which is now known as the Beaver, but they always claim that they are the true or *Pai* U-tah-ats, *pai* signifying true. Thus this latter tribe has two names: its proper name, Kwi-um-poos, derived from the district of country which it now inhabits, and Pai U-tah-ats, the name derived from the country from which it was driven; and by the surrounding tribes it is called indiscriminately by either name.

It seems that the war which resulted in this new occupation of the country was somewhat general among the surrounding Indians, and that the original U-tah-ats had as allies several other tribes to the south and west; and thus it happens that all of the Indians who fought with the Pai U-tah-ats are sometimes called by the same name as a general designation, though known to the surrounding tribes by their several proper names; but the white man has taken this name, Pai U-tah-ats, and extended it to many other tribes even in Northern Arizona and Southern California, and a group of Indians about Walker River and Pyramid Lake in Nevada, whose confederate name is Pa-ri-o-too, have received the same name, Pah-Utes.

There are other classes of names by which tribes are known to each other—names which are not used by the tribes themselves, referring to some peculiarity of habit or custom, such

as the means by which they obtain subsistence, either fishing or hunting; or perhaps some term of derision, if the tribes are enemies, is seized upon as a name. All of the tribes speaking the Ute language call the Indians of the plains, indiscriminately, Sa-in-ti-kai, or "Dog-eaters." A group of tribes in Central Nevada formerly used stone knives made out of white quartz, and were called To-Sa Wates, or "White Knives," by the surrounding tribes. The Navajos are called the Pah-ga-wates, or "Reed Knives," and every tribe or group of tribes may be known by several different names given to them by different peoples. A few of these later names have been learned by the white men, and corrupted and extended far beyond the original signification, and have become the names by which the various Indian tribes are now known to civilized men—the Indians themselves recognizing these later names, though each tribe clings to its primitive cognomen. This is but a brief outline of this system of naming tribes and confederacies; there are many other interesting facts concerning it.

The ancient inhabitants of the valley of the Colorado, whose remains have been studied for several years by Professor Powell, have also claimed his attention this year. Many other ruins have been discovered, some of their ancient picture-writings collected, and many of their stone implements found. The Professor is now prepared to indicate on his map the position of many scores of these ancient towns or hamlets now found in ruins on the eastern side of the Colorado, in the valleys of the Yampa, White, Grand, San Juan, and Little Colorado; and on the western side of the Colorado, in the valleys of the Uintah, Peace, San Rafael, Dirty Devil, Escalante, Paria, and Kanab Rivers. Mr. Hillers, the photographer of the expedition, has made a fine series of negatives, one suite of landscapes along the Green, another of the Uintah Indians.

THE ARCTIC LAND AND POLAR SEA.

An exhaustive investigation to determine the continental or oceanic character of the arctic polar regions has been based by Dr. J. Chavanne mainly upon the results of meteorological observations in those regions, in connection with other facts ascertained through the series of North Polar ex-

peditions, including that of Dr. Hall. The conclusions reached from a consideration of the thermal and hygrometric condition of the winds, as well as of the distribution of temperature in the arctic regions, are summed up as follows: 1. The longitudinal axis of the arctic land-system (which most probably consists of islands separated by narrow arms of the sea, perhaps only fiords) passes over the mathematical pole, and Greenland, therefore, north of Shannon Island, does not trend toward the northwest, but up to 83° or 84° of latitude extends in a northerly direction, and then in a north-northeasterly or northeasterly direction. 2. The coast of this arctic land-system will therefore be met between 25° and 170° of longitude east of Greenwich, at an average latitude of 84° to 85°, and the west coast between 90° and 170° west from Greenwich, at a latitude varying between 86° and 80°. 3. Robeson Channel, which suddenly extends north of latitude 82° 16′, curves at 84° of latitude, while still widening, sharply toward the west; and hence Smith Sound stands in continuous open connection with Behring Strait. Grinnel Land is therefore an island that probably stretches as far as 95° west from Greenwich, and the Parry Islands fill the sea toward the south, westward of Jones Sound. 4. The sea between the coast of the arctic land and the north coast of America is penetrated by a branch of the warm drift-current of Kuro Siwo passing through Behring Strait, and reaching as far as Smith Sound, and it is therefore at times and in places free from ice. 5. The Gulf Stream, flowing northward between Bear Island and Nova Zembla, washes the north coast of the continent of Asia, and unites on the east of the new Siberian Islands with the western branch of the Gulf Stream, flowing northward along the west coast of Spitzbergen, passes beneath the polar current to the north of the Seven Islands, and comes to the surface again at a higher latitude, and washes the coast of the arctic land, the climate of which is consequently affected on both sides by a temporarily open sea, and the formation of perpetual ice and extremes of cold are therefore altogether impossible. 6. The average elevation of polar land above the level of the sea diminishes toward the pole. 7. The sea between Spitzbergen and Nova Zembla up to Behring Strait is free from ice, in places even in winter, and is navigable in the fall and

summer. 8. Two courses to the pole, involving most promise of results, are the sea between Spitzbergen and Nova Zembla and that north of Behring Strait to the coast of the unknown polar land.—*Geography and Exploration of Polar Regions, No.* 93.

EXPLORATIONS IN 1874 OF LIEUTENANT G. M. WHEELER, UNITED STATES ENGINEERS.

The officers and civilian assistants of Lieutenant Wheeler's explorations were engaged during the year, until the commencement of the field season, late in June, in their regular office duties in the several branches of the work. Lieutenant S. E. Tillman, Corps of Engineers, having been relieved from the work, was ordered to report for duty with one of the Transit of Venus parties. Lieutenant R. L. Hoxie, another of the Engineer officers connected with the survey in 1872–73, was ordered to duty as engineer for the Board of Public Works, District of Columbia. The force, however, was increased by one officer (Lieutenant Price) of the Corps of Engineers and three officers selected from the line of the Army. The results from the office work have been the publication of the Progress Report of 1872, a preliminary catalogue of plants gathered in 1871, '72, and '73, and a preliminary report upon the ornithological specimens collected in 1871, '72, and '73—the first in quarto, the two latter in octavo. An advance edition of the topographical atlas sheets, comprising four of the main sheets, embracing an area of little more than 70,000 square miles, and other physical sheets, was also published. The total professional force taking the field was 3 officers of the Corps of Engineers, 3 officers of the line of the Army, 2 acting assistant-surgeons, 1 hospital steward, 2 additional astronomical assistants, 11 topographical assistants, 11 meteorological assistants, 2 paleontological assistants, 2 natural-history collectors, 1 photographer, 1 property agent, 1 disbursing clerk, 1 property clerk. While the party was engaged in field operations, an office force, consisting of 3 draughtsmen and 1 computer, was constantly engaged; and 1 clerk, in charge of the general records and revision of the manuscript for the final reports, was also of their number, with the requisite number of guides, cargadores, packers, cooks, laborers, etc. Nine separate parties took the field for oper-

ations in portions of Nebraska, Utah, Colorado, New Mexico, and Arizona.

On the 7th of June, Dr. Rothrock, in charge of a natural-history party, departed for his field of operations in New Mexico and Arizona, accompanied by Mr. Henshaw as ornithologist, and one barometric observer; the party being charged with filling in gaps in the areas left vacant as to natural-history collections in previous years, also with certain hypsometrical determinations. Their outward route was to lead from Santa Fé to Fort Wingate, New Mexico; thence to Camp Apache, Arizona; thence *via* New Camp Grant to Camp Bowie; thence to Camp Crittenden, the most southerly point; thence returning *via* Camp Apache, Fort Tulerosa, and Fort Craig to Santa Fé, which point was reached about the middle of November.

Their results, as indicated by the reports, have been elaborate and exhaustive, numbering large collections, especially in botany—no less than 900 species of plants, of 15 specimens each, having been secured; and in ornithology a collection of bird-skins over 1000 in number, besides general collections in other branches of natural history. These, in common with other parts of the collections made, were, upon being received at Washington, distributed at once into the hands of competent specialists for study, either through the Smithsonian Institution or the office of the Survey.

The main or receiving party of the astronomical parties took station at the observatory constructed by the Survey in 1873 at Ogden, Utah, about July 1st, and besides connecting directly with the United States Naval Observatory at Washington, with a view to a further check upon the determination of the meridian of the observatory at Ogden, which is assumed as the main meridian of the Survey, made further observations for the determination of the latitude of that point, and received signals sent by the party under Dr. F. Kampf, at Las Vegas and Cimarron, New Mexico; Sidney Barracks, Julesburg, and North Platte Station, Nebraska. These parties concluded their observations about November 1st; the observatory having been in charge of Mr. J. H. Clark, with one assistant. Dr. F. Kampf was provided with two assistants for the greater part of the season, and carried on as usual, in addition to the regular longitude and latitude ob-

servations, hourly meteorological observations at the most southerly stations.

The Western Union and Atlantic and Pacific Telegraph Companies allowed, through the kindness of their presidents and managers, the gratuitous use of their wires from these points to the observatory, which has again greatly facilitated the operations of the year. It is proposed during a subsequent season to supply from the observatory at Ogden the time at mean noon each day to the main points upon the Union Pacific and Central Pacific Railroads and the Utah Central Railroad, considerable differences of time having been found to exist between the present determinations at the easterly and westerly extremities of these lines to their different stations along this immense latitudinal stretch.

At each of the astronomical stations substantial brick or stone monuments have been placed, and meridian marks defined with exactness. The true meridian of the place is laid upon the ground, as well as the measurement of a base at each of the points, and its connection with developed bases and vertices of triangles, either established for immediate use, or that they may be taken up hereafter in the prosecution of surveys from these points, either governmental, or those made by corporations or private parties. The main or supply party, under Lieutenants Wheeler and Whipple, operated for the greater part of the season in the western and southwestern extremity of the San Luis Valley, the basins of the San Antonio and Cornejos creeks, the head-waters of the San Juan River, and in the valley of the same. The party was composed, besides the commissioned officers, of two topographers, one meteorologist, two odometer recorders, with the usual number of packers, etc. A branch of this party returned early in October to close examinations of the ranges fronting the plains between Mosco Pass, or what upon old maps is termed Robideau's Pass, southward to the Trenchera Peak and the crests of the Spanish Peaks, with a view to fill out more definitely the nearly meridional profiles that are to grow out of the survey. Lieutenant Whipple, with the remainder of the party, intended to reach the mouth of the San Juan. Nothing definite as to their results has as yet been reported.

Lieutenant Marshall's course was along the head-waters of

the Arkansas, Gunnison, and Uncompahgre Rivers, expecting to occupy six main triangulation stations necessary to connect the belt established in Colorado in 1873 to the southward. In their movements they were so fortunate as to discover an original pass through the main ridge or backbone of the Rocky Mountains, which may be described as follows:

It is just south of Hunt's Peak, near the head of the middle fork of Poncho Creek, to the head-waters of the Gunnison. It is lower than all others across the Pacific divide in Colorado save the Coochetopa, and is superior to all save the Coochetopa and the Tennessee. A good wagon road, with an average grade not exceeding 212 feet to the mile, can be constructed over it; and from Pueblo, Cañon City, Denver, or the Upper Arkansas, it will cut off nearly eighty miles in the distance to the Gunnison River and the mines at its head.

Lieutenant Marshall and party visited Pagosa Springs about the 10th of October for supplies, and thence *via* the head-waters of Cornejos and Las Animas or Purgatore Rivers reached Trinidad, where the season was closed, and a base was measured, the same having been commenced late in November. The number of miles traveled by this party was 2456.

The party under Lieutenant Blunt, accompanied by two topographers, one meteorologist, and one odometer recorder, occupied the area bounded on the north by the latitude of Trinidad, west by the summit of the main range leading southward to Las Vegas, New Mexico; thence east along the parallel of Las Vegas to the meridian bounded by 104° 07′ 30″. This comprises a part of the basins of the Cimarron, Mora, and Pecos Rivers. The country about the head-waters of these streams proved especially rich in topographical material entirely new to geographical science, and their detailed work joined that of the parties to the westward.

The party under Lieutenant Price, Corps of Engineers, assisted by three topographers, one meteorologist, and one mineralogist and chemist, occupied a line so chosen as to reach the number of main triangulation stations selected for them, and an area for minute survey bounded on the north by the latitude of Tierra Amarilla, south by the latitude of Las Vegas, west by longitude 108° 15′, and easterly by the area occupied by the party under Lieutenant Blunt. Part of their duties consisted in measuring base lines at Santa Fé and Las Vegas.

The area assigned to Lieutenant Birnie, who was assisted by two topographers, one odometer recorder and meteorologist, was from a point on the summit of the range leading south from Trenchera Peak, immediately west of the Spanish Peaks, to the head of the Taos Creek basin; thence westerly to longitude 108° 15′, and northerly along this to the latitudinal line passing through Tierra Amarilla; and thence by a line reaching from Tierra Amarilla to Trenchera Peak. The party was successful in accomplishing their work over this area, and, crossing the range late in the season, measured a base at the astronomical station at Cimarron.

A special party for natural-history researches and paleontological collections, under Dr. Yarrow for a part of the season, and Professor Cope from the 15th of September up to the close of the season, operated on a line from Pueblo to Fort Garland, through the Sangre de Christo Pass, and down the valley of the Rio Grande, striking at Taos and San Ildefonso upon beds of vertebrate and invertebrate fossils found there; thence to Santa Fé, and south to Algedones; thence north and westward to Tierra Amarilla, and thence south and west to Gallinas Creek, Cañon Largo, and Nacimiento, returning *via* Cornejos, Fort Garland, etc., to Pueblo. This party was also accompanied by a topographer, whose death by an accidental shot from a pistol is the only casualty thus far to be noted through the season. The results have been extremely rich in many ways, adding largely to the present stock of new and rare forms, especially of vertebrates in the eocene formation, and progress reports are already in press from Professor Cope on this latter subject.

The more important results in the several branches of the survey may be succinctly set forth as follows. Here we note—

Astronomy, the occupation by the main parties of stations at Las Vegas and Cimarron, New Mexico; Sidney Barracks, Julesburg, and North Platte, Nebraska; the determination of the latitude of Pueblo; the connection of the observatory at Ogden with the Naval Observatory at Washington. It may here be stated that the observatory at Ogden had been before connected with that established in Temple Square, Salt Lake City, where astronomical co-ordinates were determined when the United States Coast Survey were connecting longitudi-

nally Cambridge, on the Atlantic coast, with their station at San Francisco, on the Pacific. It (Ogden) has also been connected with the meridian established by the United States Lake Survey at Detroit, Michigan, which in turn has been determined with regard to the meridian of the observatory at Washington. This third check will serve to give results from which by the theory of probable errors the resulting probable errors of the observatory at Ogden with regard to Washington, and also from further data with that of Greenwich, will be determined.

Geodesy.—Seventy-nine main triangulation stations have been occupied, and main and minor topographical stations, extending a net-work over the entire mountain area occupied (the number of which is not known at this time), have been localized. Base lines have been or are to be measured at Trinidad and Pueblo, Col.; Cimarron, Las Vegas, and Santa Fé, New Mexico. These measured and developed bases control the triangulation reaching westward, and connecting the belts of 1873 in Colorado, New Mexico, and Arizona. A series nearly in the same meridian reaches from Hughes, Col., on the north, to Las Vegas, New Mexico, on the south; and other geographical positions of points have been determined in advance by parties of the Survey, sufficient in number to control belts of triangulation reaching in either direction north or south from the line of the Union Pacific and Central Pacific Railroads.

Improvement as to the instruments, celerity of movement of the parties, on account of the fact that no Indian difficulties are expected, the facilities from preliminary information obtained from the reports and maps of Lieutenant Ruffner, the General Land Office map, and a late map issued of Colorado and New Mexico, have all conspired to render the finished labors of this season of a more experienced force more valuable than any heretofore.

Meteorology.—The usual observations, entirely of a practical character, of all the moving field parties for the determination of altitude, have been dotted over the entire area, so as to give, together with the topographical lines rigidly measured, sufficient material upon which to base a series of contour maps, conjectural, of course, to a large extent, but useful for geological delineation.

Paleontology.—The results from this branch are the collection of over one hundred species of vertebrates, with many new genera, and more than one hundred species of invertebrates. The former are in the hands of Professor Cope for study, and the latter are to be taken up in connection with a large number now being reported upon by Professor C. A. White, of Bowdoin College, who has already determined 160 species new to science from the collections of 1871, '72, and '73.

Natural History.—So little has been heard from the parties, that it is impracticable to set forth with any accuracy the really great amount of work done at a minimum of expense, and but a few of the new species collected can here be referred to. The party operating in New Mexico and Arizona in charge of Dr. Rothrock have secured over 900 species of plants of 15 specimens each, over 1000 bird-skins, representing several species new to science, or to the United States, besides numerous insects, reptiles, fish, Indian crania, dresses, implements, etc.

The party operating in New Mexico and Colorado, under Dr. Yarrow and Professor Cope, in addition to the collection of fossils already mentioned, secured many fine specimens of insects, reptiles, and fish. Of the latter, quite a number of Cyprinoids from the tributaries of the Rio Grande are as yet undescribed. An interesting discovery by this party was that of an ancient village on the Chama at Abiquiu, near which was found a pre-historic cemetery containing numerous remains of the former people of this valley. A number of these skeletons were secured for the Army Medical Museum. The ethnological collection of the recent Indian tribes made by this party is also large and interesting.

The collector accompanying Lieutenant Wheeler's party, Mr. Aiken, has also made a very fine collection in all branches of natural history, and quite a number of his specimens are new to the fauna of Colorado.

The parties will return from the field of survey early in December, and resume, as usual, their office work in Washington, condensing the material as rapidly as possible into the form of reports, to be embraced either in quarto publications of the Survey, the Annual Report of the Chief of Engineers, or in such minor publications as it may be found neces-

sary to issue from time to time. These three classes of publications, together with the topographical and geological atlases, comprise the form in which the results of the Survey are to appear from time to time. 'Sheets 50, 58, 59, and 66 are executed in crayon, together with the general topographical sheet of the territory west of the Mississippi. A sheet of conventional signs has already been added to the advance edition of the atlas, and four other sheets, Nos. 45, 55, 57, and 67, are ready for the lithographer. The geological atlas sheets, based on atlas sheets Nos. 50, 59, 66, 68, are in the hands of the lithographer, and will soon be published. These fourteen sheets will illustrate the results up to the close of the season of 1873, and will possibly be published before long in a form for more general distribution throughout the country.

As usual, characteristic landscape and stereoscopic negatives of peculiar mountain forms, singular scenery, ruins, specimen groups of the different Indian tribes and individuals encountered, views of the Mexican and Puebla Indian habitations, etc., have been secured.

Besides the officers in charge, the following officers and civilian assistants have been engaged upon the Survey during the past season:

1st Lieutenant William L. Marshall, Corps of Engineers, Executive Officer, Party No. 1, First Division.
1st Lieutenant P. M. Price, Corps of Engineers, Executive Officer, Party No. 1, Second Division.
2d Lieutenant C. W. Whipple, Third United States Artillery, Executive Officer, Main or Supply Division.
1st Lieutenant S. E. Blunt, Thirteenth United States Infantry, Executive Officer, Party No. 2, Second Division.
1st Lieutenant R. Birnie, Thirteenth United States Infantry, Executive Officer, Party No. 1, Second Division.
Acting Assistant-Surgeon H. C. Yarrow, U. S. A., in charge of Natural-History Branch.
" " " J. T. Rothrock, U. S. A., Botanist.
Civilian Assistant Professor E. D. Cope, Paleontologist.
" " Professor C. A. White, Paleontologist.
" " John H. Clark, Astronomical Observer.
" " Dr. F. Kampf, Astronomical Observer.
" " Louis Nell, Chief of Triangulation.

Civilian Assistant Gilbert Thompson, Chief Topographer.
" " Frederick A. Clark, Chief Topographer.
" " E. J. Sommer, Topographer.
" " J. C. Spiller, Topographer.
" " R. J. Ainsworth,* Topographer.
" " William A. Cowles, Asst. Topographer.
" " F. O. Maxson, Asst. Topographer.
" " William R. Atkinson, Asst. Topographer.
" " William H. Rowe, Asst. Topographer.
" " Francis Carpenter, Asst. Topographer.
" " Dr. O. Loew, Mineralogist.
" " G. K. Gilbert, Geologist.
" " W. W. Hance, Assistant Mineralogist.
" " H. W. Henshaw, Ornithologist.
" " C. A. Aiken, Ornithologist.
" " T. H. O'Sullivan, Photographer.
" " J. B. Minick, Meteorologist.
" " John E. Weyss, Draughtsman.
" " Charles Herman, Draughtsman.
" " J. C. Lang, Draughtsman.
" " F. M. Lee, Computer.

EXPLORATIONS OF DR. HAYDEN IN 1874.

Owing to the delay in the passage of the appropriation bills, various parties of the Survey could not take the field until July; but this was in one respect an advantage, as the assistants were thereby enabled to prepare for publication the information collected during the long field season of 1873. By the wording of the appropriation, Dr. Hayden was assigned to the survey of Colorado Territory. The field parties, eight in number, were fitted out at Denver; that of the Chief Geologist, Dr. Hayden, making detailed studies of certain areas for the solution of problems of special importance.

The party of the Geographer of the Survey, Mr. James T. Gardner, was engaged in carrying on the primary triangulation on which the maps are based. The party of the Quartermaster, Mr. James Stevenson, was chiefly occupied in supplying the various parties with provisions and stores. A photographer, with a party under Mr. W. H. Jackson, and four surveying parties, under Mr. A. D. Wilson, Mr. A. R.

* Accidentally killed.

Marvin, Mr. Henry Gannett, and Mr. G. R. Bechler, carried on distinct and independent work.

Professor Hayden's party made a special study of the Elk Mountains, a very high and interesting group, lying between the Grand and Gunnison rivers, on the western side of the main ranges of Rocky Chain. They also traced and mapped carefully the coal-rocks and overlying formations along the eastern base of the mountains, from the Arkansas River to near the northern boundary of the territory. Mr. Gardner's party measured a new base five and a half miles long in the upper part of the San Luis Valley, about one hundred and twenty miles northwest of the Denver base. The chain of triangles connecting these two bases was completed, and the system extended a hundred miles to the west and sixty miles to the south of the San Luis base. Fourteen stations were occupied, ten of which were over 13,000 feet high. From these the principal peaks over an area of 20,000 square miles were located. Mr. Jackson, after taking many views to illustrate the great group of mountains among which the San Juan mining region is situated, in Southwestern Colorado, penetrated beyond them, and, traveling westward along their base, discovered some very interesting groups of ancient ruins in the valley and in the faces of the cliffs. These were carefully photographed and described.

Mr. Wilson and his corps were engaged in working up the great group of mountains about the head of the Rio Grande River. These peaks are undoubtedly the highest in the Rocky Mountains. Twenty-seven of the topographical stations visited by him were over 13,000 feet high. His survey extended westward to longitude 108° 15′ between the 37th and 38th parallels, and including between 5000 and 6000 square miles. Mr. Gannett's district lay northward, between the Grand and Gunnison Rivers, and Mr. Marvin's farther north, between the Grand and White Rivers. Both of these surveys extended westward to about longitude 108° 30′, each covering from 5000 to 6000 square miles. Mr. Bechler was engaged around the South Park, and along the eastern slope of the Colorado Front Range. From 18,000 to 20,000 square miles of mountain country have thus been topographically and geographically mapped by the Survey, and large collections made by all the parties.

G. NATURAL HISTORY AND ZOOLOGY.

MICROSCOPICAL EXAMINATION OF AIR.

A valuable document has lately been published by the English government in Calcutta, consisting of a report upon a microscopical examination of air, prepared by Dr. D. Douglass Cunningham. This gives the result of examinations of atmospheric dust from various localities, as deposited on ledges, leaves of trees, etc., and upon moist glass slides. It includes also observations on organisms contained in dew, in rain-water, and in the air of sewers. The work is illustrated by fourteen plates, giving magnified representations of the objects as seen by the microscope. Among the general conclusions obtained by Dr. Cunningham, at least so far as observations in the vicinity of Calcutta are concerned, are the following: (1.) Specimens of dust washed from exposed surfaces can not be regarded as fair indices of the constituents of atmospheric dust, as they are liable to contain bodies which may have reached the surface otherwise than by means of the air, and they do not, at any rate, indicate the relative proportions of the different constituents. (2.) There is generally but little trace of distinct infusorial animalcules in dry dust; and although distinct bacteria are frequently to be found among deposits from the moist air of the sewers, they are almost entirely absent as constituents of dry dust. (3.) The addition of dry dust, which has been exposed to tropical heat, to putrescible fluids, is followed by a rapid development of fungi and bacteria, although recognizable specimens of the latter are very rarely to be found in it while dry. (4.) Spores and other vegetable cells are constantly present in atmospheric dust, and usually occur in considerable numbers. The majority of them are living, and capable of growth and development. The amount of them present in the air appears to be independent of conditions of velocity and direction of wind, and their numbers are not diminished by moisture. (5.) No connection can be traced between the numbers of bacteria, spores, etc., present in the air, and the occurrence of diarrhœa, dysentery, cholera, ague, or dengue, nor between the presence

or abundance of any special form or forms of cells and the prevalence of any of these diseases. (6.) The amount of inorganic and amorphous particles and other *débris* suspended in the atmosphere is directly dependent on conditions of moisture and of velocity of wind.

These results on the part of Dr. Cunningham appear to agree quite closely with those of Robin, but differ more from those of Pouchet and Ehrenberg. In regard to the origin of bacteria, the present experiments are not opposed to the belief in the transmission of organisms by the atmosphere, for they were actually observed among the particles in moist air. In conclusion, Dr. Cunningham remarks that there are many interesting questions which are suggested in connection with the fact of the presence of such considerable numbers of living cells in the air as he has found. What becomes of them when drawn into the respiratory cavities of animals? Is their vitality destroyed; and, if so, how are they got rid of? Are they capable of undergoing development within the organism, and do they exert a prejudicial influence on the recipient? These and other similar questions, the author remarks, are only to be answered by means of patient and continued experiment.—*India Report.*

LIMIT IN THE AVAILABLE POWER OF MICROSCOPE LENSES.

According to Professor Abbé, of Jena, the limit of capability of a microscope, in showing the structure of tissues and the character of minute objects, has nearly, if not entirely, been reached, higher powers than those now in use giving rise to optical phenomena which are likely to completely mask the structure and character of the object under examination. Thus it may happen that while different structures give the same microscopical image, like structures will give different images; and while systems of fine lines, and the like, may appear ever so distinct and well marked in the microscope, we are not entitled to regard such appearances as of morphological significance, but merely as physical phenomena from which nothing can be inferred, except the presence of such structural conditions as are capable of producing the diffraction effects obtained.

These observations apply more especially to the marking of certain diatoms and of striated muscular fibre. According

to Professor Abbé, by no microscope can parts be distinguished if they are so near to each other that the first bundle of light rays, produced by diffraction, can no longer enter the objective simultaneously with the undiffracted cone of light. —12 *A*, IX., 191.

THE SAND-BLAST FOR MAKING MICROSCOPIC SLIDES.

The proceedings of the Queckett Microscopical Club mention that the sand-blast has been successfully employed by H. F. Hailes for excavating hollows in glass slides, to be used as cells for microscopical uses. For wet mounting, it is said, the roughness of the bottom is no hinderance to mounting objects in balsam, as the lower surface of the cell is rendered perfectly transparent by contact with the mounting material. For dry mounting it is also said to answer well.

DETERMINATION OF BLOOD STAINS.

According to the report of a recent commission, we learn that by the use of the microscope, either alone or associated with chemical analysis and the spectroscope, it is now possible to obtain certainty as to the question whether stains are really those of blood or not, although it is hardly practicable, except when the stains are recent, to decide whether they are from man or belong to some other animal.

If the stains are old and the blood is changed, a reaction with the tincture of guaiacum will suggest the presence of blood; but its actual existence can not be ascertained without spectrum examination, or the production of crystals of hydrochlorate of hematine. One of the two is sufficient.—1 *A*, *December* 5, 1873, 291.

LIFE IN DEATH.

At the meeting of the Swiss Scientific Association, in August, 1873, Professor Karsten stated that the development and increase of embryonic cells contained in the cell fluid continues for a longer or shorter time after the death of the organism, unless suppressed by great dryness, extremes of temperature, want of oxygen, or chronic agents that interfere with assimilation. He considered the bacteria, vibriones, etc., present in closed cells of the tissues of diseased or dead organs, and regarded as the carriers of contagion, to be in real-

ity pathological cell forms, as of pus, yeast, etc. These, in consequence, do not represent distinct organic varieties, and should not be looked upon as complete organic species, since no act of reproduction, eggs nor seeds, can be recognized, while the active movements of the vibriones are no indication of an independent nature. There is nothing left but to regard these objects, long since named pseudophytes by Müller, as pathological products, since careful observation will satisfy any one that they originate within the cells of plants and animals, and are not introduced into them like parasites. Again, the bacteria, vibriones, etc., developing within the diseased organ, and contributing to its rapid disorganization, may become free, and induce to some extent the same disease in healthy individuals, as is known with certainty of the cells of different kinds of lymph, pus, bacteria, and micrococci.—3 *C*, *October* 27, 1873, 860.

ALCOHOLIC FERMENTATION BY MOULD (MUCOR MUCEDO).

The statement by Bail, and subsequently also by Rees, that the germs of *Mucor mucedo*, when immersed in a fermentable liquid, multiply by budding, like beer-yeast, and occasion alcoholic fermentation, has been investigated by Fitz. The liquids employed were heated, in vessels closed with cotton, to the boiling-point, and after cooling were impregnated with one or more germs of *Mucor mucedo*, readily obtained by cultivation on horse manure in an atmosphere saturated with moisture, and tested as to genuineness by means of the microscope. The air was allowed to remain in some of the vessels, and displaced in others by carbonic acid immediately after the germs were added. In those in which oxygen was present the mucor germs developed into a luxuriant mycelium, converting the sugar in its development into carbonic acid and water, until all the oxygen absorbed by the liquid was thus consumed, when the mycelium divided into separate cells, which multiplied by budding and formed mucor-yeast. In those free from oxygen the mucor germs developed directly, and immediately into cells increasing by budding, with the separation of the sugar into the usual products of fermentation. These results agree decidedly with Pasteur's theory. It was further ascertained that mucor fermentation requires a higher temperature than that of *saccharomyces*, and that

the ferment of the former also inverted cane sugar, and also that the gas evolved in fermentation was pure carbonic acid. The mucor-yeast is, however, so extremely sensitive to alcohol that 3½ to 4 per cent., by weight, of the latter renders it slow and finally inactive, so that it can only be employed when less than 7 per cent. of sugar is present in solution. It does not produce alcoholic fermentation with dextrine, inuline, or grape sugar.—28 *C, April*, 1874, 302.

THE GASTRÆA THEORY OF HAECKEL.

Professor Ernst Haeckel, in a paper entitled "*Die Gastræa Theorie*," endeavors to show that the whole animal kingdom above the Protozoa have descended from a simple sac-like form of ancestor, whose body-wall, consisting simply of an ectodermal and an endodermal layer of cells, incloses a space —the primitive stomach. This ancestral form constantly shows itself in the development of the most diverse types—polyps, sponges, worms, anthropods, mollusks, and vertebrates. The ancestor which possessed this form Haeckel names a *Gastræa*. All the higher animals are, consequently, *Gastræades*; and though they develop into much more complicated structures than the sac-like *Gastræa*, yet they often exhibit a *Gastrula* condition in the course of their progress from the egg to the adult form. In the present memoir Professor Haeckel follows out other questions as to the muscular layers which develop in the higher *Gastræades* between endoderm and exoderm and the blood-nymph space, or "cœlom," which also makes its appearance in this position. The classification of animals on the basis of these important facts of development is attempted in detail, as well as an enumeration of the tissues of the organism according to the mode of their development.—15 *A, February* 14, 1873, 229.

BLEACHING SKELETONS.

At a meeting of the French society for encouraging national industry, Mr. Cloes stated that in using the essence of turpentine for dissolving the oil of greasy bones, which he was treating for the preparation of skeletons, he found that after an exposure of three or four days in the sun the bones became of a dazzling white. If in the shade, they required a somewhat longer exposure. The articles to be bleached must

be suspended a short distance, say half an inch, above the bottom of the bath; that is to say, above the very delicate acid layer which is thrown down by the liquid during the operation. Various articles, such as wood of various kinds, cork, etc., were acted upon in the same manner, under the same circumstances.—8 *B*, *May* 30, 1874, 1141.

CHLORAL AS A PRESERVATIVE.

The Philadelphia *Medical Times* contains an article, by Dr. W. W. Keen, upon the anatomical, pathological, and surgical uses of chloral, in which he recommends this substance very strongly for the preservation of objects of comparative anatomy and natural history. It is used by injection into the blood-vessels, or by immersion, and in his opinion it is likely to supersede many of the preparations now in use. Its special advantage is that the color of the objects is preserved perfectly, and all the parts have a natural consistency, while there is nothing either poisonous or corrosive to affect the general health or to injure instruments.

For preserving a human subject for dissection, half a pound of chloral will suffice, at a cost of a dollar or less. A solution for preserving specimens of natural history, of ten or twelve grains to the ounce of water, is quite sufficient, is much cheaper than alcohol, and the bottles, instead of being hermetically sealed, are closed by glass stoppers, or even ordinary corks. Dr. Keen has thus kept pus from various substances, and diseased growths of various kinds off other specimens, for months, and found no change whatever in their character. Chloral is extremely antagonistic to fungi and infusoria, a very weak solution of it killing them instantly. The deodorizing, as well as the antiseptic properties, are equal, in Dr. Keen's opinion, to those of any substance now known.

THE GODEFFROY MUSEUM AT HAMBURG.

Two of the merchants of Hamburg, the brothers Godeffroy, have for some years been connecting explorations in natural history with their mercantile ventures to the islands of the South Sea, and have established a museum in Hamburg, bearing the name of the "Museum Godeffroy," now under the care of Dr. Schultz, which, although confined strictly to Aus-

tralasian and Polynesian material, already occupies a very prominent rank. Combined with the exhibition of the collections and the sale of the duplicates is a series of publications based upon the material of the museum, among which one of great importance has just appeared, in the form of the results of an investigation of the fishes, by Mr. Andrew Garrett. Mr. Garrett is an American by birth, having been employed in the Museum of Comparative Zoology at Cambridge, after which he was engaged by the Messrs. Godeffroy in their own behalf.—12 *A*, *December* 18, 1873, 120.

CEMENT FOR AQUARIA.

An adhesive cement for aquaria may be made, according to Klein, by mixing equal parts of flower of sulphur, pulverized sal ammoniac, and iron filings, with good linseed-oil varnish; and then adding enough of pure white-lead to form a firm, easily worked mass.—15 *C*, XXI., 335.

NATURAL HISTORY OF THE BERMUDAS.

During the past winter Mr. J. Matthew Jones, a well-known Nova Scotian naturalist, has been engaged in continuing his explorations into the natural history of the Bermudas, commenced by him many years ago. His observations prove, in his opinion, that the whole formation has suffered, at some uncertain period, considerable subsidence, attended by violence, and suggests the propriety of causing borings to be made to ascertain the true character of the island foundation, and thus solve a question of much importance to science. The vegetation of the islands he found to partake more particularly of the character of that of the Southern United States, especially as regards the flora of the coast, which consists of a mixture of West Indian forms and others imported accidentally or otherwise from Europe—species proved not to be, as a rule, widely distributed, but to be mainly local. One district in particular, not over a square mile in extent, named Walsingham, which is cavernous in a high degree, possesses plants unknown in other parts of the islands. Several species of fish new to previous collections were received by Mr. Jones. The genera *Serranus*, *Caranx*, and *Muræna* appeared to be best represented in those waters, and of the former some immense specimens were met with. *Carcharias*

obscurus exists in great abundance, while the larger sharks are not common. The *Pleuronectidæ* were not met with at all, with the exception of one species of *Rhomboidichthys*, supposed to be new. During a violent southeast gale which visited the islands in January last, hundreds of the smaller fish, some hitherto unknown to the fishermen, were cast ashore, including numerous specimens of *Aulostoma coloratum*. Mr. Jones noticed material changes in the habitat and abundance of certain marine mollusks, compared with observations made some twenty years ago. *Littorina muricata*, which used to occur in vast quantity on the shore rocks of the south coast of the main island, proved to be not nearly so numerous now; while *L. ziczac*, which until lately was comparatively rare in that locality, is now quite common. *Pecten ziczac* also, which was common about the sounds and inlets, is now confined to a few localities. Very few migratory birds visited the Bermudas during the winter of 1873–4—a strange occurrence, which may, however, be accounted for by the absence of the usual northerly gales of that season.

ABSENCE OF ANIMAL LIFE IN THE MEDITERRANEAN.

Dr. William B. Carpenter, in attempting to explain the remarkable absence of animal life in the deep waters of the Mediterranean, refers the cause, in the first place, to the muddy condition of the bottom water, resulting from the minute particles brought down from the Nile and the Rhone, and disseminated throughout the whole bed of the sea. Nothing appears to be more injurious than an extremely fine sediment of this nature continually in the process of deposition, geological evidence showing clearly that the finest-grained sedimentary deposits are usually almost destitute of resident animal life, the few fossils exhibited consisting almost exclusively of sharks' teeth, or the remains of other free swimming animals that have died and sank to the bottom; while in another part of the same stratum, composed of coarse-grained materials, life may prove to be quite abundant.

Another condition in the Mediterranean, equally unfavorable with this turbidity, if not more so, is the deficiency of oxygen produced by the slow decomposition of the organic matter brought down by the great rivers.

According to determinations made by Dr. Carpenter in 1871,

the gases boiled off from water brought up from great depths in the Mediterranean contained only about five per cent. of oxygen and thirty-five per cent. of nitrogen, the remaining sixty per cent. being carbonic acid; whereas in gases obtained from the deep waters of the Atlantic the average percentage of oxygen was about twenty, while that of carbonic acid was between thirty and forty, this large proportion of carbonic acid not appearing prejudicial to the life of marine invertebrata so long as oxygen was present in sufficient proportion. The physical cause of this deficiency of oxygen and excess of carbonic acid is found in the absence of any bottom circulation, the whole interior of the sea being in an absolutely stagnant condition. The circumstances that produce circulation in the ocean are not present here, there being no possibility of an increase of the density of the surface stratum by the reduction of temperature, involving its sinking to the bottom, to be replaced by the bottom water coming to the top. On this account the bottom water is never disturbed, and the organic matter contained in the sediment accumulated there consumes its oxygen so much more rapidly than it can be supplied from above, and diffused through the vast column of superincumbent water, that nearly the whole of it is converted into carbonic acid, scarcely any of the oxygen being left for the support of animal life. The existence of a reef across the Strait of Gibraltar also effectually prevents any circulation from the Atlantic.—18 *A*, *August* 29, 1873, 604.

THE MECHANICAL PERFECTION OF THE HUMAN HEART.

Mr. Garrod, in an interesting lecture at the Royal Institution of London, on the heart and the sphygmograph, states that the heart is to be viewed as a pump, constructed on the same principle as an engine built as indicated by himself, and so regulated by means of an elastic bag that the velocity of the working machinery does not vary with the work to be done. A large number of measurements has enabled him to show that the relative lengths of the systolic and diastolic portions of the pulse trace do not vary for any given pulse rate, but that the blood pressure in the arteries is quite independent of the pulse rate; whence it follows that the force of the cardiac muscular contraction varies directly as the blood

pressure. It may also be demonstrated that, at least approximately, the nutrition of the heart's walls must vary as the square root of the length of the diastolic period.—12 *A*, IX., 327.

HÆMOGLOBIN IN THE BLOOD OF DIFFERENT ANIMALS.

As the result of an inquiry by Quinquand, in regard to the variations in the amount of hæmoglobin in the blood of different animals, and under different physiological conditions, the following conclusions are reached:

1. The progressive diminution in the amount of hæmoglobin contained in equal volumes of the blood follows, as a rule, the steps of the animal scale.
2. The blood of young animals contains less hæmoglobin than that of adults. A line representing the amount of hæmoglobin takes the following course: It falls slightly during the first few days of extra-uterine life, rises during childhood, remains horizontal during adult life, and finally falls slowly during old age.
3. The blood of birds is much less rich in hæmoglobin than that of mammals, but the weight of the globules is rather greater in the former than in the latter, though the mammalian globules contain only a third of the quantity of albuminous material present in those of birds.
4. As a rule, females have less hæmoglobin than males.
5. The lymph of crustaceans contains four to five cubic centimeters of oxygen in 100, whereas ordinary water in the middle of winter, when completely saturated, contains only one cubic centimeter in 100.—21 *A*, *December*, 1873, 1245.

THE CIRCULATION OF THE BLOOD.

The hydrodynamic laws that come into play in the circulation of the blood through the arteries have been elucidated, from time to time, by the use of the sphygmograph, but among the various results obtained by the application of this instrument, those recently published by Mr. Garrod, of Cambridge, England, are especially worthy of notice.

We will preface a short abstract of Mr. Garrod's late investigation by the definition of two terms used by him. The cardiosystole is the interval between the commencement of the contraction of the heart and the closing of the aortic

valve in each cardiac revolution. The sphygmosystole is the interval between the opening and the closing of the aortic valve in each cardiac revolution.

The author commences by giving a table of measurements that strongly substantiate the law previously published by him: namely, that the length of the cardiosystole is constant for any given pulse rate, but varies as the square root of the length of the pulse beat. A similar series of fresh measurements shows that the length of the sphygmosystole is constant for any given pulse rate, but varies as the cube root of the length of the pulse beat. These laws apply to all the arteries examined by him, and must, therefore, equally apply to the aorta itself, and this gives him the means for deducing the relation between the whole cardiac-systolic act and the time during which the aortic valve remains open. He then deduces (from an earlier-published series of measures) the time required by the second or dichrotic wave of the pulse in traveling from the aortic valve to the wrist, and thence is able to conclude that the earlier primary wave takes the same time in going the same distance; which conclusion is shown to be justified by the agreement to the third place of decimals of measurements which have been arrived at independently, and which is great evidence in favor of the accuracy of the methods and arguments employed. The author then gives some results obtained by the employment of a double sphygmograph, by means of which simultaneous tracings are taken from two arteries at very different distances from the heart. It is shown that the time occupied by the pulse wave in traveling the distance of twenty-three and one half inches, or the difference between the wrist and ankle pulse, is 0.0012 of a minute, or 0.07 of a second of time, in a pulse of 75 per minute. This interval varies very little with difference in pulse rate, but it is proved that there is a marked acceleration of the pulse wave as it gets farther from the heart.—12 *A*, IX., 514.

NEW EXPERIMENTS ON THE VENOM OF EAST INDIAN SERPENTS.

Drs. Fayrer and Brunton have communicated to the Royal Society of London an important memoir upon the pathological action of Indian poisonous snakes, the experiments having been conducted in London with venom sent to En-

gland in a dried state. In this form it seemed to retain all its active properties, and to answer the purpose for experiments equally well with the poison of the living animal.

In these experiments the difference in the action of the poison of the viperine snakes from that of the colubrine was reaffirmed. The blood of animals killed by the former generally remained fluid after death, while that of animals killed by the latter formed a coagulum.

The immediate action of the poison was found to be due, first, to arrest of the respiration by paralysis of the muscular apparatus, by which its function is carried on; second, or by rapid arrest of the heart's action, in cases where the poison had found direct entry by a vein; third, to a combination of the two conditions; fourth, when the poison was in small quantity, to secondary causes and pathological changes. When the poison was introduced into the heart by direct entry through a vein, death was almost instantaneous.

When the virus is absorbed into the blood, either by inoculation or by application to mucous membrane, it affects the cerebro-spinal nerve centres, the nerves and their distribution, more especially the motor nerves. The sensory nerves are less and later affected, and the intelligence generally latest of all, and slightly. The complete loss of the last is mainly caused by the circulation of the venous blood, the result of the impeded respiration.

One important fact was shown by the experiments: namely, that this poison acts when introduced into the stomach, and when applied to the mucous or serous membrane. It has generally been supposed, as the result of experiment, that serpent virus could be introduced with safety into the stomach, but this seems now to be disproved.

A remarkable fact, previously announced, has been reaffirmed by these experiments: namely, that while serpent poison acts readily upon harmless snakes, it has no effect at all upon the poisonous species. Drs. Brunton and Fayrer coincide with Dr. Mitchell as to the difficulty of arresting the action of serpent poison after it has been fairly introduced into the system. It must be remembered that in very many cases, where a person is bitten, the poison is so much diluted with the juices of the mouth, or is otherwise inert, as frequently to have very little effect; but the cases are very

rare in which, when a sufficient quantity of poison has been fairly introduced, death has failed to supervene.

The remedies indicated by these gentlemen as most desirable are such as mechanically prevent the entrance of the poison to the circulation—namely, the ligature and the cautery; but these, to be available, must be applied immediately. Stimulants, such as alcohol and ammonia, are useful, especially where the poison is severe but not fatal. Other antidotes are apparently inert. Artificial respiration continued long enough to admit the elimination of the poison from the breathing organs, is serviceable under some circumstances. —12 *A*, IX., 294.

COMPOSITION OF THE CARTILAGE OF THE SHARK.

According to Petersen and Soxhlet, the fresh cartilage of the shark is composed of—organic matter, 8.03 per cent.; chloride of sodium, 16.69 per cent.; other inorganic matter, 1.08 per cent. (total inorganic, 17.77 per cent.); water, 74.20 per cent.; and the dried cartilage contains 4.80 per cent. of nitrogen, which is fifteen per cent. of the organic matter; the latter belonging no doubt to the albumen group: whether identical with chondrine from common cartilage was not investigated. The ashes gave chloride of sodium, 94.24; soda, 0.79; potash, 1.64; lime, 0.40; magnesia, 0.05; sesquioxide of iron, 0.27; phosphoric acid, 1.03; sulphuric acid, 1.88 per cent. The occurrence of a tissue so rich in chloride of sodium is an interesting physiological fact, especially since the flesh surrounding it is comparatively wanting in salt, the fresh meat containing only 1.16 per cent. of incombustible matter. The salt must therefore either be in chemical combination with the constituents of the tissue, or there must be a species of attraction in the cartilage for salt, which prevents the diffusion of the strongly saline fluid of the cartilage with the less saline of the flesh.—18 *C*, *August* 27, 1873, 553.

DEVELOPMENT OF TEETH IN THE ARMADILLO.

In studying the development of the teeth of the armadillo (*Tatusia peba*), Mr. Tomes finds, contrary to what would have been expected, that in their earliest stages the first indications of their differentiation are manifested by the formation of an "enamel organ" as in those of higher mammals;

whereas, in the teeth themselves, as is well known, there is no enamel present. Another peculiarity is that behind each primitive tooth a second smaller sac is seen, which corresponds in all its relations with the germ of the permanent tooth in other mammalia. Consequently, *Tatusia peba* at least, among the *Dasypodidæ*, is not monophyodont, as has been previously stated by Rapp, Gervais, and Flower; from which it may be inferred that the Edentata, as an order, must have descended from a truly diphyodont type, and have become subsequently specialized.—12 *A*, IX., 192.

COMPOSITION OF BONE.

According to Messrs. Marley and Donath, the compound of osseine with phosphate of lime, which exists in bones, is a mechanical mixture and not a chemical compound. The grounds of this conclusion are found in the facts that osseine, when kept in contact with phosphate of lime, does not enter into combination with it, and that other colloid bodies besides osseine and gelatine, such as albumen, when earthly phosphates are precipitated from the same solutions, are precipitated together with the phosphates.

DIFFERING STRUCTURE OF THE TARSUS IN THE CERVIDÆ.

A very suggestive anatomical fact has been pointed out by Sir Victor Brooke respecting the tarsus in certain of the *Cervidæ*. He finds that, in the species of the genus *Cervulus* (the Muntjacs), the tarsus, instead of consisting of a naviculo-cuboid bone, together with two separate cuneiform bones, has the outer of the two cuneiform masses anchylosed to the naviculo-cuboid mass to form a single bone, leaving the minute internal cuneiform free. In a very young specimen of *Cervulus muntjac* the cuboid was free, and the naviculars anchylosed to the outer cuneiform bones, showing that the tendency to blend in this direction is greater than that of the naviculars and the cuboid to combine. This same peculiarity is also found in the Pudu deer of South America.—12 *A*, IX., 191.

DUPUY ON THE FUNCTIONS OF THE CEREBRUM.

M. Dupuy, as the result of a number of experiments which he has lately made, with a view of testing the accuracy of

Professor Ferrier's researches in reference to the functions of the cerebrum, arrives at the following conclusions:

1. That it is possible by exciting certain points of the cortical layer of the cerebrum to obtain contractions in every limb.

2. That, as a rule, the fore-limb of the opposite side is that affected.

3. That the electric current must be propagated to the base of the cerebrum to excite either the nerves which arise from it or the base itself or the pons varolii.

4. That if the dura mater be electrically excited, contractions are observed in the fore leg, and generally in that of the opposite side.

5. The fact that the galvanoscopic frog is thrown into a state of contraction when its nerve touched some point of the cerebral mass far from the point excited, confirms the view that the electric current is propagated.

6. Contrary to the effects obtained by Ferrier, M. Dupuy has never been able to obtain any effects upon the tongue, either of projection or of retraction.

7. The whole cortical layer of the cerebrum is probably a centre of reflection for a certain kind of sensibility capable of exerting a reflex action on motor or sensory nerves; but that its preservation is not indispensable for the manifestation of voluntary and even intelligent action.

8. In the animals on which M. Dupuy has experimented contractions of the opposite limbs can still be produced, even after the ablation of the optic thalami and corpora striata of the opposite side to that on which the irritation is applied. —13 *A*, *February* 14, 1874, 178.

COMPOSITION OF THE BODY FLUIDS OF FISH AND INVERTEBRATES.

Messrs. Rabuteau and Papillon have been prosecuting some inquiries into the various liquids in the cavities of fish, crustaceans, and cephalopods, and state that the peritoneal fluid found in rays is neutral, or slightly acid, and contains a small quantity of an albuminoid material, which forms a rather thick layer on the surface when the liquid is evaporated. When kept, it gives off an ammoniacal odor resembling methylamine. The gastric juice of the ray is rather acid,

and the presence of hydrochloric acid was clearly demonstrated. Hydrobromic acid, however, was not found. The blood of sea-polyps gives no absorption band under the spectroscope. It becomes slightly blue when traversed by a current of carbonic-acid gas. The blood of the crab exhibits similar characteristics; and both contain a coagulable substance which cold nitric acid turns yellow.—21 *A*, *November*, 1873, 1150.

COAGULABILITY OF SERUM AND ALBUMEN DEPENDENT ON THE PRESENCE OF CARBONIC ACID.

A very suggestive and important paper has lately been presented to the Academy of Sciences of Paris by Messrs. Mathieu and Urbain, in which they show that if the gases dissolved in the serum of blood be completely removed, an albuminous liquid is obtained which does not coagulate even at a temperature of 212°. The same fact was also ascertained in regard to the albumen of the egg, and by the use of proper pneumatic apparatus it became possible to extract from this albumen, not only the gas, but also the volatile salts which it contained; and it was furthermore determined that, while the removal of the gas renders the albumen uncoagulable by heat, the disappearance of the volatile salt converted it into a substance analogous to globuline.

Other experiments showed that the greater part of the gas in the albumen consists of carbonic acid, and that it is really the presence of this which imparts the property of coagulability. The other ingredients are nitrogen and oxygen in very small percentage. The amount of carbonic-acid gas varied from sixty-five to eighty-four per cent.; of oxygen there was about two per cent., and of nitrogen from three to five per cent.

When the normal amount of oxygen and nitrogen was restored to the albumen, no change took place in its properties, but the introduction of a sufficient quantity of carbonic acid was found to impart the power of coagulability under the influence of heat. This property of removing the coagulability of albumen by the extraction of carbonic acid, and restoring it on its return, will doubtless be applied with very great effect to many manufactures in which albumen enters largely.

A further experiment by these gentlemen was in reference to albumen which has been diluted with ten to fifteen times its volume of distilled water. In this condition it is not coagulable, as the greater part of the carbonic acid becomes disengaged. If, now, the solution be raised to 86° Fahr., and traversed by a current of carbonic acid gas, the albuminoid substance becomes completely precipitated. The authors suggest a method by which albumen that has once been coagulated by heat or by an acid may possibly be restored to a soluble condition.—6 *B*, *September* 29, 1873, 706.

INFLUENCE OF ELECTRIC STIMULATION ON THE BRAIN AND SPINAL CORD.

Dr. Ferrier, of King's College, London, has lately prosecuted sundry inquiries into the influence of electric stimulation upon the brain and spinal cord, and in a paper recently published gives certain conclusions at which he has arrived, which, although imperfect, as he admits, he considers worthy of being laid before the world, and subjected to a thorough criticism by other experimenters. They are as follows:

1. The anterior portions of the cerebral hemispheres are the chief centres of voluntary motion, and of the active outward manifestation of intelligence.

2. The individual convolutions are separate and distinct centres, and in certain definite groups of convolutions (to some extent indicated by the researches of Fritsch and Hitzig), and in corresponding regions of non-convoluted brains, are localized the centres for the various movements of the eyelids, the face, the mouth and tongue, the ear, the neck, the hand, foot, and tail. Striking differences, corresponding with the habits of the animal, are to be found in the differentiation of the centres. Thus the centres for the tail in dogs, the paw in cats, and the lips and mouth in rabbits, are highly differentiated and pronounced.

3. The action of the hemispheres is in general crossed, but certain movements of the mouth, tongue, and neck are bilaterally co-ordinated from each cerebral hemisphere.

4. The proximate causes of the different epilepsies are, as Dr. Hughlings-Jackson supposes, discharging lesions of the different centres in the cerebral hemispheres. The affection may be limited artificially to one muscle or group of muscles,

or may be made to involve all the muscles presented in the cerebral hemispheres, with foaming at the mouth, biting of the tongue, and loss of consciousness. When induced artificially in animals, the affection, as a rule, first invades the muscles most in voluntary use, in striking harmony with the clinical observations of Dr. Hughlings-Jackson.

5. Chorea is of the same nature as epilepsy, dependent on momentary and successive discharging lesions of the individual cerebral centres. In this respect Dr. Hughlings-Jackson's views are again experimentally confirmed.

6. The *corpora striata* have crossed action, and are centres for the muscles of the opposite side of the body. Powerful irritation of one causes rigid pleurosthotonos, the flexors predominating over the extensors.

7. The optic thalamus, fornix, hippocampus major, and convolutions grouped around it, have no motor signification, and are probably connected with sensation.

8. The optic lobes, or *corpora quadrigemina*, besides being concerned with vision and the movements of the iris, are centres for the exterior muscles of the head, trunk, and legs. Irritation of these centres causes rigid opisthotonos and trismus.

9. The cerebellum is the co-ordinating centre for the muscles of the eyeball. Each separate lobule (in rabbits) is a distinct centre for special alterations of the optic axes.

10. On the integrity of these centres depends the maintenance of the equilibrium of the body.

11. Nystagmus, or oscillation of the eyeballs, is an epileptiform affection of the cerebellar oculo-motorial centres.

12. These results explain many hitherto obscure symptoms of cerebral disease, and enable us to localize with greater certainty many forms of cerebral lesion.—20 *A*, *Aug.* 30, 1873, 233.

MALFORMATION OF FISH EMBRYOS.

Fish-culturists, especially those who have to deal with the various species of the *Salmonidæ*, are frequently struck with the numerous cases of malformation in the embryos hatched out by them; these sometimes constituting a marked percentage of the whole number, resulting, it is supposed, from too great rapidity of development, or some other at present unknown agency. In some instances the percentage is so

large as materially to affect the number of salable fish produced, as they sooner or later succumb in the struggle for existence.

Dr. Knoch, of Moscow, has lately been studying the nature of malformations in the trout, salmon, and whitefish, and finds the most common monstrosities to consist in the possession, first, of two heads; second, of a double vertebral column and cord; third, of malformation as regards divergence of the body from its axis of length; fourth, of defects of the organs of locomotion; fifth, of anomalies in the vegetative sphere; sixth, of defects in the organs of sense.

It is possible that similar malformations occur in equal proportions in other fishes, but such of these as come under the cognizance of the student are usually so small as not to be appreciable. Malformations are, indeed, quite common in the goldfish and carp, particularly the former; and the Chinese have already developed a number of special races bearing distinctive names, and characterized, among other features, by the possession of an extra number of tails.—18 *A*, *January* 2, 1874, 382.

HEREDITARY TRANSMISSION OF PHYSICAL PECULIARITIES.

As a contribution to the question of the hereditary transmission of physical peculiarities, it may be stated that, at a meeting of the Physiological Society of London, Mr. E. Ward exhibited two feet of a fawn, the mother of which had double hind-feet, and had for several years brought forth young having the same malformation.—*Proc. Zool. Soc., London, January* 20, 1874.

RAPIDITY OF THE ACTION OF THE NERVES.

Some experiments have recently been made by Exner to determine the reaction time of the sensorium; that is to say, the time required to convey an impression along the nerves to the brain, and to convey an order from the brain to any portion of the body, together with the interval required by the brain to deliberate and act. Exner's method of observation consisted in stimulating some portion of the body, and requiring the person immediately to make a signal by pressing a telegraphic key with the right hand. Marks were produced on a blackened cylinder, both at stimulation and at sig-

naling, and the interval was noted by the ordinary methods of the chronograph. The reaction time ranged between thirteen and thirty-six hundredths of a second, and seems independent of age, being shortest in those who have the habit of concentration. The tables also show it to have been shortest when the stimulation was applied to the eye by means of an electric shock; and then follow, in order, an electric shock given to the finger of the left hand, a sudden sound, an electric shock to the forehead, a shock to the right-hand finger, the sight of an electric spark, and, lastly, a shock communicated to the toes of the left foot.—12 *A*, IX., 115.

THE SEA-SERPENT ON THE SCOTCH COAST.

The latest sea-serpent story is that of Mr. James M. Jouass, as communicated to Mr. Francis Francis, the well-known fish-culturist, and published in the London *Field* for the 15th of November. This gentleman is vouched for by Mr. Francis as being a man of science, and not easily duped. The first appearance of the animal was about the middle of September, near Lothbeg, in Scotland, when it was seen by two ladies. The next morning an animal about forty or fifty feet long was seen by Dr. Soutar rushing along near the shore, and occasionally raising its head to a height of about four feet above the water. The next day at noon, on a calm sea, Mr. Jouass saw, through a glass, about half a mile out, a floating object which was certainly part of some sort of beast, dead or basking. It drifted along with the tide, but at no time did it raise itself higher than when first seen. The color was brown and light yellow, the apparent size about eight or ten feet. The cut accompanying the communication in *The Field* shows a not very distant resemblance to some of the sketches heretofore made of the so-called sea-serpent.—19 *A*, *November* 15, 1873, 511.

A NEW BONE CAVE IN SWITZERLAND.

In the early part of the year 1874, in the canton of Schaffhausen, some children, when on a botanical excursion, made the interesting discovery of a bone cave near Thaingen, full of bones and flint implements, which were subjected to the criticism of Dr. Keller. Among these were numerous bones bearing drawings executed with a sharp flint, one of which

was that of a reindeer browsing, remarkable for precision of drawing and delicacy of execution. According to M. Bertrand, these remains must be over 4000 years old; and he suggests that the contribution of the troglodyte populations of Gaul to European civilization may have been the arts of design.—13 *A*, *March* 21, 1874, 320.

MAMMOTH CAVE IN POLAND.

A bone cavern has lately been discovered in Poland, near Wieruskow, and named the Mammoth Cave, in allusion to the number of bones of the European mammoth which it has yielded. It has also furnished a large number of stone implements, the materials for their construction having been obtained from siliceous nodules in the neighboring oölitic rocks. —15 *A*, *May* 9, 1874, 633.

KJOEKKENMÖDDING IN NORWAY.

Zeigler has lately discovered near Drontheim, in Norway, what is said to be the first illustration of the kjoekkenmödding (or shell heaps) yet found in that country; this consisting of a large mass of broken animal bones and shells mixed with a little earth. In the centre of this was a dark layer, indicating traces of fire, in the form of bits of charcoal, etc. —30 *C*, *January*, 1874, 5.

PREPARED HEADS OF MACAS INDIANS.

Among the choicest and rarest objects of archæological museums may be mentioned certain heads prepared by the Macas Indians of Ecuador, residing upon the Upper Amazon, and which are remarkable for their diminutive size—in this respect not exceeding that of a small monkey. Numerous hypotheses have been presented in regard to the manufacture of these objects; but, according to a recent communication from Sir John Lubbock, instead of being the heads of enemies, they are actually the mementos of departed friends. They are severed from the body, and then prepared by boiling with an infusion of herbs, until the bones and other internal parts can be removed through the hole of the neck. Heated stones are then introduced into the cavity, and the skin of the head dried up, and at the same time greatly contracted. A string is then run through the head for convenience of suspension

in the hut, and the head, having been solemnly abused by the owner, has its mouth sewed up to prevent a chance for a reply.—15 *A*, *August* 30, 1873, 278.

THE FOSSIL MAN OF MENTONE.

Much interest was excited a year or two ago at the discovery by Mr. E. Rivière of sundry prehistoric skeletons in the caverns of Baousse-Roussé, near Mentone, these presenting some marked peculiarities as compared with the human framework of more modern times.

Referring to previous articles on this subject, we may remark that in June of 1873 an adult skeleton was discovered in cave No. 6, one other having been previously found there; and near to it, and almost at its feet, were the remains of a youth of about fifteen years of age. The bones of another child were found on the 27th of January, 1874, in cavern No. 1.

According to Dr. Rivière, the discovery of this new skeleton confirms the existence of certain supposed rites among these early people, the red color of the bones, and of the hearth upon which they rest, being due to the presence of iron ore, which had been apparently heaped up purposely over the body. There were also implements of bone and stone, ornaments of shell and of perforated teeth, as in the other case.

The skull presents much the same peculiarities as in the other instances, being decidedly dolichocephalic, with a powerful lower jaw, prominent thick teeth, and the muscular attachments strongly marked. Around the head were numerous shells belonging to *Nassa*, *Buccinum*, *Columbella*, and *Cypræa*, and with some canine teeth of the stag, both shells and teeth occurring in very large numbers.

Besides these, there were bones, teeth, and mandibles of ruminants, pachyderms, and rodents, some fragments of deer antlers, etc.—1 *B*, *May* 17, 1874, 97.

TREE-VILLAGES OF THE SOLOMON ISLANDS.

The report of the cruise of the British ship *Blanche* among the Solomon Islands gives an account of a visit to one of the tree-villages peculiar to Isabel Island, one of the group. At the summit of a rocky mountain, rising almost perpendicularly to the height of about eight hundred feet, is situated a grove

of gigantic trees, in the branches of which are houses of the people. The stems of these trees run up perfectly straight, growing without a branch to the height of from fifty to one hundred and fifty feet. One ascended by Captain Stimpson, of the *Blanche*, had a house built in it at a height of eighty feet from the ground; one close to it, at one hundred and twenty feet. The only means of approach to the houses is by a ladder made of a creeper, suspended from a post within the house, and which can be hauled up at will. Each house contains from ten to twelve natives, and an ample store of stones is kept for defense. These houses are, in fact, used as fortresses and for sleeping-places, while those for ordinary use are at the foot of the trees. The object of this curious mode of building is to secure protection against their fellow-natives, as they wage a constant mutual warfare, often for the purpose of getting each other's heads as trophies.—12 *A*, *November* 20, 1873, 54.

WOLF-CHILDREN IN INDIA.

From the days of Romulus and Remus to the present, stories are continually rife of children having taken up their abode with wolves, and assuming more or less of their character. A recent contribution to the literature of this subject is found in the June number, for 1873, of the *Proceedings of the Asiatic Society of Bengal*, where Mr. V. Ball, of the Geological Survey of India, presents a note of children found living with wolves in the northwestern province of Oude. This gentleman gives an extract from a letter from the superintendent of the Orphanage at Secundra, in relation to a boy who was found, as it states, in a wolf den where some Hindoos were hunting wolves. He had been burned out of the den with the wolves, and brought to the Orphanage with the scars and wounds still on him. In his habits he was a perfectly wild animal in every respect, drinking like a dog, and liking a bone and raw meat better than any thing else. He would never remain with the other boys, hiding away in any dark corner, and never wearing clothes, but tearing them into fine shreds. He died a few months after being taken.

Another boy, also found among wolves, and likewise brought to the Orphanage, is now about thirteen or fourteen years of age, and has been at the Orphanage more than six

months. He has been taught to make sounds, but can not yet speak. He has learned to eat cooked meat, but still does not disdain to pick a bone.

These boys were remarkable for the facility with which they moved about on their hands and feet, exactly as if they were real wolves. Before eating or tasting any food, they smelled it, and if the smell did not suit them they threw it away.—*Proc. Asiatic Soc. of Bengal, June*, 1873, 128.

HABITS OF A YOUNG GORILLA.

Mr. R. B. Walker writes from Corisco Bay, in Western Africa, in regard to a young gorilla which he had alive for some time, and hoped to forward to the Zoological Society of London. Contrary to the usual assumption in regard to this species, the specimen in question proved to be extremely docile and perfectly tame. When first purchased it was shy and suspicious, but not spiteful. At the expiration of about a week it was led around without resistance, and it ate whatever eatable thing it could lay its hands on, including a basin of condensed milk with a raw egg beaten up in it. It was quite tame, eating, sleeping, and playing with a large bull-terrier, the two animals being constantly together. It unfortunately disappeared one night, and was supposed to have fallen overboard.—11 *A*, *November* 4, 1873, 684.

PAUCITY OF MAMMALS IN CUBA.

The great paucity in species of native mammals in the island of Cuba, and the West Indies generally, is a remarkable fact, a recent catalogue by the well-known Cuban naturalist, Dr. Gundlach, giving but twenty-four species, of which nineteen consist of various species of bats. One is a *Solenodon*, belonging to the insectivora; three are species of *Capromys*, a form of hystricine rodents, allied to the agoutis; and one the manatee. All the species, with the exception of the manatee (which really belongs to the waters and not to the land), are extremely diminutive. Nor is there any reason to suppose that at the time of the discovery by the Spaniards there were more kinds or of larger size. It is probable, however, that at one geological period the West Indies were connected with the continent, or formed a large area; and certain paleontological indications show that at one time the fauna was

more varied. Quite a number of large species of fossil mammalia have been described by Professor Cope, and doubtless others yet remain to be discovered.

FOSSIL SIRENIANS IN GREAT BRITAIN.

The first evidence of the existence of fossil sirenians in Great Britain was presented by Professor Flower at the late meeting of the Geological Society in the form of a species of *Halitherium*, called by him *H. canhami.* It was part of the collection of crag fossils gathered by the Rev. H. Canham from the Red Crag, near Woodbridge, in Suffolk.—12 *A*, *November* 6, 1873, 13.

EMBRYOLOGY OF THE LEMURS.

M. Milne-Edwards has recently investigated the embryology of the lemurs, and finds the placentation of these animals to be quite distinct from that of the *Quadrumana*, to which order they have been heretofore referred. The resemblances are to the *Carnivora.* Hence Professor Milne-Edwards is inclined to regard them as a distinct order between the two mentioned. This conclusion as to their affinities is a highly interesting confirmation of the view recently expressed by Professor Cope, in Hayden's Geological Survey of the Territories for 1872, that the quadrumanous genus *Tomitherium*, discovered by him in the Wyoming tertiary, combined equally the characters of the coati and the kinkajou (South American *Carnivora*) with those of monkeys. Thus the study of the skeleton of vertebrates foreshadows the results derived from the soft parts.

GENESIS OF THE HORSE.

Professor Marsh, in the *American Journal of Science* for March, presents a communication upon certain fossil equine mammals from the tertiary formation of the West, in which he throws some new light upon the much-vexed subject of the genealogy of the modern horse. In reference to this point, he remarks that the American representative of the modern horse is the extinct *Equus fraternus* of Leidy, a species almost if not entirely identical with the Old World *Equus caballus* of Linnæus, to which the present species belongs.

The line of succession of the European horse has been pre-

sented by Huxley; but Professor Marsh thinks that this with the American horse was more direct and the record more complete. The natural sequence of the descending order would be—*Orohippus*, of the eocene; *Miohippus* and *Anchitherium*, of the miocene; *Anchippus*, *Hipparion*, *Protohippus*, and *Pliohippus*, of the pliocene; and *Equus*, quaternary and recent.—4 *D*, *March*, 1874, 247.

NEW ZEUGLODON IN FRANCE.

Delfortrie has lately announced the occurrence of *Zeuglodon* in the Faluns, in the southwest of France, and remarks upon the interest attaching to this fact. The zeuglodon has been hitherto supposed to be confined to America, the representative of the same group of fossil cetaceans in Europe being the genus *Squalodon*. The species is described as *Zeuglodon vascanum*, Delfortrie, and has the same crenulation of the edges found in the rest of the family.

It will be remembered by our geological readers that the far-famed *Hydrarchos*, or supposed sea-serpent, of Koch, discovered by him in the Mississippi valley, and mounted so as to represent an animal one hundred feet in length, after being considered for a time as a reptile, was ultimately shown to be a *Zeuglodon*, and to belong to the family of cetaceans.—1 *B*, *February*, 1874, 297.

NEW SKELETON OF THE MEGATHERIUM IN THE JARDIN DES PLANTES.

The French scientific journals express much gratification at the recent introduction into the museum of the Jardin des Plantes of the most complete skeleton of the megatherium yet known. This was obtained many years ago by Mr. Seguin, a French collector, in South America; but it is only recently that it has been cleaned from its matrix, and placed where it can be examined.

A writer in *Nature* informs us that this skeleton forms the fifth of all that are known to public museums—one in Madrid, the second in London, the third in Buenos Ayres, and the fourth, a very imperfect one, in the Normal School of Paris.

These have all been found in the pampas of the Argentine Confederation or in Paraguay, principally upon the banks of the Rio de la Plata. The specimen now introduced to the

notice of the scientific world is not the largest known, although it is believed to be the most perfect. It is about 17½ feet long, 18½ feet high, and 7½ broad.

These remains have hitherto been in the post-pliocene formation, and the fact that all the skeletons have been very perfect, with the bones in proper relationship to each other, seems to suggest that the animals were overwhelmed by a sudden deluge of mud, stone, and gravel, and were not floated in water for any length of time.

It may be interesting to state that Mr. Segnin obtained human bones in such connection with the remains of the megatherium as to leave no doubt in his mind that all were buried simultaneously, and by the same catastrophe.

ANTARCTIC WHALING.

The two arctic whalers, Captain David Gray, of the *Eclipse*, and Captain John Gray, in view of the diminution of whales in the arctic seas, have lately turned their attention to the Antarctic Ocean, and have come to the conclusion that whales of a species similar to the right-whale, or Greenland whale, exist in great numbers in the vicinity of the south pole, and that the establishment of a whale-fishery within that area will be attended with profitable results. They accordingly propose to leave Peterhead in August for that portion of the antarctic area lying between the meridian of Greenwich and ninety degrees west, as being the locality promising the most valuable results. This ground they are to reach in the end of October, and the fishery is to be prosecuted during the four following months, the vessels returning in May. The distance does not exceed 7200 miles from Great Britain, or a two months' easy passage. They recommend the use of two steamers of 800 tons and 120 horse-power. — 6 *A*, *March*, 1874, 513.

EXTERMINATION OF BUFFALOES.

The enormous extent of the destruction of buffaloes on the Western plains seems to have undergone no diminution during the present winter, and there is every reason to fear that, should this continue a few years longer, the animal will become as scarce as is its European congener at the present day. Notwithstanding the countless herds of bisons that

covered the plains of Central Europe in the time of Cæsar, and subsequently, it is stated that all that are now living in Europe consist of a herd of less than fifty in Lithuania, where they are carefully preserved by the Emperor of Russia, a death penalty being executed upon those who willfully molest them. A few are still living in the Caucasus, but even there they are extremely rare.

At present thousands of buffaloes are slaughtered every day for their hides alone, which, however, have glutted the market to such an extent that, whereas a few years ago they were worth three dollars apiece at the railroad stations, skins of bulls now bring but one dollar, and those of cows and calves sixty and forty cents respectively.

A recent short surveying expedition in Kansas led to the discovery of the fact that on the south fork of the Republican, upon one spot, were to be counted six thousand five hundred carcasses of buffaloes, from which the hides only had been stripped. The meat was not touched, but left to rot on the plains. At a short distance hundreds more of carcasses were discovered, and, in fact, the whole plains were dotted with putrefying remains of buffaloes. It was estimated that there were at least two thousand hunters encamped along the plains hunting the buffalo. One party of sixteen stated that they had killed twenty-eight hundred during the past summer, the hides only being utilized.

It is, of course, very important that some remedy should be provided for this evil, but what will answer the purpose it is difficult to suggest. As these animals range almost entirely within the territories of the United States, it is within the province of Congress to enact laws prohibiting their destruction, but the difficulties lie in the matter of enforcing them. Possibly some provision for seizing and confiscating the green hides, along certain lines of railway, or during certain seasons of the year, as a part of the penalty to be attached to the violation of the law on the subject, might accomplish the result; but, at any rate, the subject is one that demands the prompt attention of legislators, in view of the relationship of this animal to the welfare of the Indians, and the reaction which their destitution will produce upon the scattered white settlements in the vicinity of the range of both buffaloes and Indians.

DEINOMYS, A NEW GENUS OF HYSTRICINE RODENTS.

Dr. Peters has published the description of a remarkable new genus of hystricine rodents, from the high mountains of Peru, to which he has given the name *Deinomys branchii.* The animal is of about the size and general appearance of the well-known paca (*Cœlogenys paca*), but has only four toes, short, rounded ears, a fissured upper lip, very broad incisor teeth, and a bushy tail. It is closely allied to other South American genera, but has characteristics entitling it to a distinct generic rank. Its resemblance to the paca is increased by its black color, with a series of white spots arranged in stripes on either side of the body. It occurs in the colony of Amable Maria, on the Montaña de Vitoc, Peru, where, however, it is rare.—*Monatsbericht der K. P. Akademie der Wiss.*, 1873, 552.

DISCOVERY OF A NEW DEPOSIT OF MOA BONES IN NEW ZEALAND.

The discovery of a large deposit of moa bones is announced as having been made in a swamp at Hamilton, in Otago, including, in addition to the bones of the dinornis, those of aptornis, harpagornis, etc. The whole collection has been secured by the curator of the Otago Museum.

THE NEW FOSSIL BIRD OF THE SHEPPEY CLAY.

Much interest was excited some time ago by the announcement by Professor Owen of his discovery, in the London Sheppey clay, of the skull of a bird provided with distinct tooth processes along the edges of each jaw, and which was named by him *Odontopteryx toliapicus.* In the November number of the journal of the Zoological Society of London Professor Owen's paper appears, with full illustrations, showing the species to possess very remarkable characteristics. The dentary projections, which are processes of the bone, are from three to four lines in length, and the larger ones were probably about ten or twelve in number on each side of each jaw.

Although in some respects this bird resembles the gannets and the geese, it is altogether unique, and not to be referred to any class. There is no doubt, however, in Professor

Owen's mind, that it was a warm-blooded biped, with wings, and that it was web-footed, and probably a fish-eater; and that in the capture of its slippery prey it was aided by this armature of the jaws.

This bird is not to be confounded with the *Ichthyornis* of Professor Marsh, which, indeed, is still more abnormal, in the fact that the teeth, instead of being merely processes of the jaw-bone, such as is seen to some extent in birds like the merganser, are actually implanted in distinct sockets.—*Quar. Jour. Geol. Soc. of London, November* 1, 1873, 511.

FOSSIL EGG FROM THE CHERSONESUS.

A fossil egg recently found in the Chersonesus has been added to the treasures of the St. Petersburg Museum at a cost of $850. It is 7.2 inches in length and 6 inches in the shortest diameter; its capacity is reckoned equal to that of forty to forty-four hen's eggs. It is thus larger than the egg of the ostrich, but much smaller than that of the epiornis, which has a capacity equal to that of 148 hen's eggs. Nothing is said of the family to which this egg belongs.—12 *A, January* 22, 1874, 235.

RELATION BETWEEN THE COLOR OF BIRDS AND THEIR GEOGRAPHICAL DISTRIBUTION.

A communication has lately been made to the Academy of Sciences of Paris, by Mr. Alph. Milne-Edwards, upon the relations existing between the color of certain birds and their geographical distribution, having special reference to the fauna of Polynesia. His inquiries have embraced not only researches into the absolute fact of melanism in the way of black plumage, but also the degree to which this influence has modified the true colors. Referring to the fact that birds with black plumage are found, in all parts of the globe, in certain families of wide geographical extent, the tendency to melanism is exhibited decidedly only in the southern hemisphere, and especially in the portion embracing New Zealand, Papouasia, Madagascar, and intermediate regions. Thus, in the swans, all the species of the northern hemisphere are white; in New Holland, however, there is a species that is entirely black, while in Chili and elsewhere in South America we have the Coscoroba swan, entirely white, with some

of the quills black, differing in this latter respect alone from the allied species in China.

Again, in speaking of the black parrots, Professor Edwards remarks that none of these are to be found black in America or Asia, nor in Africa excepting along the borders of the Mozambique Channel, though they are not rare in the more southern regions included in the limits mentioned, some of them being entirely black, and others with a gloss of this color, so as to obscure the other tints.—6 *B*, *Dec.* 29, 1873, 1551.

NEW CLASSIFICATION OF BIRDS.

Mr. A. H. Garrod has lately presented to the Zoological Society of London a new scheme for the classification of birds, based principally on the disposition of their muscles and other soft parts. The classifications previously made use of have rested mainly upon the osteology and the external anatomy. Sundevall, according to Mr. Garrod, is the only ornithologist who has made any generalizations respecting myology which have a very important bearing upon the subject.

Mr. Garrod has found, in comparing birds but distantly related to each other, that important myological differences exist between them; and the more he extended his researches, the more distinctly has he been able to point out striking family characters which he thinks should be used in classification. The muscles that he takes principally into consideration are the five following: (1) The *femoro-caudal*, which runs from the *linea aspera* of the femur, near its head, to the sides of the tail vertebræ; (2) the *accessory femoro-caudal*, which runs parallel to the last, and behind it, from below the femur-head to the ischium; (3) the *semitendinosus*; which crosses the first-named muscle superficially, and arises from the lower part of the ischium, to be inserted into the inner side of the tibia-head; (4) the *accessory semitendinosus*, which arises from the distal end of the *linea aspera*, and joins the fibres of its larger namesake obliquely just before their insertion; (5) the *ambiens*, that peculiar slender muscle which arises from just above the acetabulum, and, after running obliquely through the ligamentum patellæ, joins the tendon of the *flexor perforatus digitorum*.

He has made observations on these five muscles with more than five hundred species of birds, and presented to the society a table, showing, by means of formulæ, to what extent these muscles are represented in their development in the different families. The scheme of classification, based upon these muscles, as furnished by Mr. Garrod, does not differ materially from the classification hitherto adopted, although our prejudices are occasionally somewhat shocked, as by the close apposition of the accipitres and steganopodes.

The general symmetry of the classification, however, is an ample warrant to Mr. Garrod for insisting that whatever features are adopted, myology has an equal right to be taken into consideration.—12 *A*, IX., 291.

AFFINITIES OF HELODERMA HORRIDUM.

Professor Gervais has made a communication upon the teeth of the American reptile known as *Heloderma*. A species of the genus is abundant in Southern Arizona, where it is called a scorpion, and is reputed by the natives to be extremely venomous, although experiments carefully prosecuted by Dr. B. J. D. Irwin, of the United States Army, failed to exhibit any evidence of this fact. There is, as Gervais and others have found, a striking relationship between it and some of the poisonous serpents in the possession of a longitudinal furrow on the back part of the teeth, as if to carry poison from a gland. Whether the animal be actually poisonous or not, Gervais calls attention to the peculiar structure of the teeth (as shown by the microscope in a cross-section), the basal part of which is filled by folds, or plications, directed outward, toward the fine exterior coat of enamel.—6 *B*, *November* 10, 1873, 1069.

OCCURRENCE OF A CUBAN CROCODILE IN FLORIDA.

In a communication of Mr. C. J. Maynard to the *American Sportsman*, describing his adventures during a visit to Florida in the winter of 1873–74, he speaks of the capture of *Crocodilus acutus* on a journey from Lake Harney to Indian River, at a place called Cabbage Slough.

If he be correct in his identification, this constitutes the second specimen known to have been killed in the United States, the first having been taken by Professor Wyman near

New Smyrna, Florida. Mr. Maynard, however, adds that during a previous expedition to the west coast of Florida he found quite a large number inhabiting the mouths of rivers that empty into the Gulf of Mexico.

THE CROCODILE AS A POACHER.

Dr. Day, in his work upon the fisheries of India, mentions the crocodile as one of the principal agencies in the destruction of the fish of that country, which is so great, indeed, in some localities as almost to depopulate the waters. These animals are frequently found in the irrigation canals, where they establish themselves below the locks in the pools stocked with fish, and the number devoured by one crocodile in a single day is almost incredible.—2 *A*, *December* 6, 1873, 457.

FOSSIL CERATODUS IN QUEENSLAND.

A paleontological fact of extreme interest is the discovery, by Mr. Gerard Krefft, of a tooth of an extinct species of *Ceratodus* found in the alluvial deposits of the Darling Downs district of Queensland. This he has named *C. palmeri*. The tooth is larger than the corresponding one of *C. forsteri* (the living species), the enamel being rather coarser, and the surface more undulated.—12 *A*, *February* 12, 1874, 293.

POISON OF THE WATER LIZARD.

In a communication recently made to the Linnæan Society of London, by Miss Ormerod, upon the cutaneous exudation of the *Triton cristatus*, an European water lizard, interesting experiments are detailed, which probably equally well illustrate the peculiarities of the many corresponding species found in the United States. Miss Ormerod remarks that, in their natural state, these Tritons are scentless, but on being alarmed or irritated they emit an odor strongly resembling that of bruised poppy-heads, which is quite perceptible, and remains for a considerable time on the hands after touching them. When the animal has escaped from the water and become partly dry, this odor is extremely pungent.

On one occasion, a number of these animals, immediately after being taken from the water, were placed under the influence of chloroform vapor, when a viscid slime immediately exuded from the surface. On tasting a very small quantity

of this, Miss Ormerod found that it inflamed her lips, and produced a peculiar sensation of dizziness and stupor, lasting for a considerable time. When introduced into the mouths of the salamanders themselves, or into those of small animals of other species, a foaming at the mouth was soon noticed, and occasionally slight convulsions. There seems to be no doubt that this exudation answers a genuine purpose of defense or protection to these otherwise weaponless creatures.

On another occasion, a part of the back and tail of a living Triton were gently pressed between the teeth so as to cause it to give out its acrid exudation. The first effect was a bitter sensation in the mouth, with irritation of the upper part of the throat, numbing of the teeth more immediately holding the reptile, and a strong flow of clear saliva. This was followed by a spasmodic action about the mouth and by headache, lasting some hours, by general discomfort of the system, and subsequently by slight shivering fits.—*Jour. Linnæan Society*, II., 493.

THE STRUCTURE OF THE LANCELET.

One of the first-fruits of the establishment of Dr. Dohrn's station for marine research, at Naples, is seen in a memoir by Dr. Stieda upon the structure of the lancelet (*Amphioxus*), of which he made a large collection, preserving some in spirits and others in chromic acid. This curious animal, which occurs in many parts of the globe, has been the subject of investigation by Müller and other writers, but many important additions to what has been heretofore known have been made by Dr. Stieda. The structure of the *chorda dorsalis* was carefully examined, and shown to be made up of very elongated fibrous cells, which run obliquely through the chorda, and partly mingle with each other in the transverse direction, and partly in the longitudinal extension of the chorda. The sexes can not be distinguished externally, but the microscope determines the question at once, rendering improbable the suggestion of Owen that the amphioxus may prove to be the larva of some fish.—13 *A*, *December* 1, 1873, 455.

FOOD OF THE SHAD.

As a general rule, the stomachs of shad, when taken in nets during their spring migration, very rarely contain food of

any kind, and it is therefore somewhat difficult to determine of what their sustenance consists. On the 11th of April, however, Mr. Elwood R. Norny, of Philadelphia, while attending his shad and bass fishery at the head of Delaware Bay, near Fort Penn, noticed that one of the shad was unusually distended, and on opening it found the stomach crammed to repletion with a small crustacean, which from his description is probably a species of *Mysis*. Dr. Leidy also records an instance where a shad taken in Delaware Bay, in the fall, had several fish in its stomach.

FISH LIVING IN DRIED MUD.

Mr. Dareste, in a paper presented to the Academy of Sciences of Paris upon the fishes of the family of *Symbranchides*, refers to a species which was collected in Siam by Bocourt, the well-known traveler. This author remarks that his attention was first called to the fish while crossing a wide plain, by seeing a native forcing into the ground a long iron rod, with a kind of harpoon at the end of it. After several essays the rod was drawn out with one of these fish impaled upon its hooks. The fish was alive, but appeared to be stupid, and very sluggish in its movements. The traveler ascertained that during part of the year the waters covered this plain for several months; and that, as they receded, these fish collected in the shallow basins, where the water remained longest on the surface; and as this evaporated, the fish buried themselves in the mud, to remain until the next inundation.—6 *B*, *October* 20, 1873, 878.

THE "NERFLING" FISH.

Among the fishes more recently suggested as suitable for introduction into fish-ponds is one known as the "aland" or "nerfling." Its usual size is about twelve inches, but it sometimes attains the length of eighteen or twenty, with a weight of six pounds. The typical species is colored very much like the ordinary chubs and minnows of American waters. A reddish variety, *Cyprinus orfus* of Linnæus, with colors as brilliant as those of the gold-fish, has been cultivated for a long time in Bavaria, where it is known as "orfee."

The species is now in great request as an ornamental fish for ponds, in consequence of its habit of swimming in schools

on the surface of the water, and thus being almost always in sight. It has been introduced into England by Lord Arthur Russell, and placed in a lake at Woburn Abbey, from which it is probable that it will be distributed into other portions of the United Kingdom. Specimens were lately brought to the United States and placed in the ponds of Dr. Slack at Bloomsbury, New Jersey.

A writer in the London *Field* remarks in reference to this fish that it forms a parallel to the gold-fish of China, which in its typical form is by no means golden, but olivaceous and silvery, and that the redness represents a peculiar form of albinism, which has become permanent.—19 *A*, *March* 28, 1874, 299.

LONGEVITY OF FISHES.

Dr. Buchner, of Giessen, presents to the Dorpat Natural History Society his contribution to the facts bearing upon the longevity of fishes, in which he remarks that a large eel is now living in a stone trough about ten feet long, with a board top, through which is continually running a stream of cold water. The eel has been kept in that trough for twenty-six years, and now measures nearly five feet in length, the weight about a year and a half ago being four and a half kilogrammes. The length of the fish when placed in the trough is not known, but its weight was one and a quarter kilogrammes. It was estimated to be about eight years of age at that time, and consequently would now be thirty-four. The food of this animal consists of small trout, of chopped liver, and of coagulated blood.—*Dorpat Nat. Hist. Soc.*, III., 1872, 312.

SPAWNING OF WHITING-POUT.

According to the observations of Mr. Henry Lee upon whiting-pout (*Gadus luscus*), a small species of gadus kept in the Brighton aquarium, the spawning season of these fish is about the middle of November, the eggs being so numerous as actually to cloud the water of the tank in which they are contained, each globule being a little smaller than a granule of boiled sago. Their specific gravity is nearly that of sea-water, and when placed in perfectly still water, when the embryo is developed, they exhibit a tendency to sink to the bottom; but if the water is agitated they rise, and some time elapses before they again settle.

The development appears to be exceedingly rapid. In two days after the ova were first seen in the tank, not only was the form of the fish discernible in many of them, but the young fry, just hatched, were detected in the water enjoying independent life. They were about three sixteenths of an inch in length when first hatched out.—2 *A*, *Dec.* 6, 1873, 565.

EGGS OF THE SILURIDÆ.

It is an interesting fact in the economy of certain fishes, especially of those belonging to the family of the *Siluridæ*, that the mouth constitutes the nest for hatching the eggs, these to the very limited number of from five to twenty being kept in this cavity, usually that of the male, until they are hatched. They are probably caught up after exclusion and fertilization, and retained. Some of these eggs are half an inch in diameter. The fact of this peculiarity in the case of the genus *Arius* and some of its allies in America has long been known; and Dr. Day announces the same condition in certain Indian species of *Arius* and *Osteogeniosus*.—12 *A*, *February* 5, 1874, 272.

SENSIBILITY OF FISH TO POISONS.

It has been the prevailing impression that fishes are less liable to the influence of poisons than the other vertebrates; but this is shown to be incorrect by a series of experiments lately prosecuted by Rabuteau and Papillon in the laboratory of Concarneau. In one case, some small fishes, such as eels, rays, sea-horses, etc., weighing from one hundred and fifty to five hundred grains each, were placed together in a quart of sea-water in which were dissolved two and a half centigrammes of strychnine. At the end of four hours all were dead, with the usual symptoms of strychnine poisoning. The convulsions were most appreciable in the flat-fish and in the rays.

Some very curious experiments were made in the way of hypodermic injections of strychnine in certain rays; and the authors recommend the very young of this species as eminently suited for watching the progress and symptoms of poisoning, since the skin of the belly is so transparent as to permit all the changes which occur in the lungs, heart, and the larger vessels to be observed without difficulty. Experi-

ments were conducted with strychnine, morphine, thebaine, and the iodide of tetramethyl-ammonium.—6 *B*, *Dec.* 8, 1873.

STRUCTURE OF THE EMBRYONIC CELLULE IN THE EGGS OF BONY FISHES.

Balbani, as the result of investigations of the embryonic cellule in the egg of the bony fishes, informs us that the egg itself presents the same composition as that which he had previously endeavored to show exists in the egg of the articulates: namely, that in both forms of animals the germ is in the form of a vesicle, spread out on the surface of the egg, and containing the nutritive vitellus in its interior. Not only do the plastic and nutritive portions exhibit a complete mutual independence, from the earliest point when ovogenic phenomena are appreciable, but each has a different origin. Thus, while the nutritive substance is deposited in the centre of the egg, with or without the occurrence of foreign elements from outside (a point still discussed by authors), the germ is formed on the periphery, under the influence of a particular cellule—the embryogenic—which proceeds from the wall to the ovarian compartment, and which subsequently becomes united to the young ovule.—6 *B*, *December* 8, 1873, 1377.

THE EMBRYOLOGY OF TEREBRATULINA.

A memoir upon the embryology of *Terebratulina*, by Professor Morse, has just been published by the Boston Society of Natural History, this being the result of a thorough investigation in regard to the development of this genus of the brachiopod shells found so abundantly on the coast of Maine.

Professor Morse's labors were mainly prosecuted at Eastport, and extended through a period of several years. He found that the species spawns throughout the entire summer season (at least from April to August), but that investigations in the earlier part of the season were preferable, since, with the increasing warmth, the development is more rapid than is convenient to the observer.

VARIATION IN THE BANDED SHELLS OF CALIFORNIA.

Dr. J. G. Cooper has lately published a paper upon the law of variation in the banded shells of California, in which he renews certain considerations previously stated in Vol. IV.

of the *American Conchological Journal*. The principal law deducible from the facts observed by him tends to show that species, sub-species, and varieties, living in cool, damp situations, become more highly developed (but not always larger) than others, the shell assuming a more compact (imperforate) form, and losing those indications of immaturity referred to, viz., sharp, delicate sculpture, bristles, and angular periphery. These characteristics, however, remain more or less permanently for indefinite periods, and give that fixedness to the various forms, even when living under the same conditions, which enables us to retain them as *sub-species*, differing from *varieties* in permanency, and from *races* in not inhabiting distinct regions. *Arionta arrosa* and *Lysinœ dupetithouarsi* are thus the most highly developed group in California.—*Proc. Cal. Acad. Sci.*, V., 125.

THE FOOD OF THE OYSTER, AND A NEW PARASITE.

In a paper read before the Boston Society of Natural History, Professor John M'Crady treated of the food and reproductive organs of the oyster, with an account of a new parasite, as observed in oysters taken in Charlestown Harbor. The oyster lives in the mud bottom, imbedded in a thick layer of low organic forms, which covers the whole surface of the mud as a yellowish organic film. The upper portion of this growth is tenanted by diatoms, sporules of algæ, and by rhizopods, of which the former two, at least, seem to form the principal food of the oyster.

In the reproductive organ of these oysters a peculiar entozoon was found, which, in its most advanced stage, is branched, with two long tentacle-like organs at one extremity. This parasite appears for a time completely to destroy the fertility of the oyster; and to its abundance may perhaps be due the seasons of short spawn often noticed by those engaged in the oyster culture. This parasite has been named *Bucephalus cuculus*.

VOMITING A LIVER-WORM.

At a late meeting of the Academy of Natural Sciences of Philadelphia, Professor Leidy made a communication in reference to a worm vomited by a Chinese boy in Canton, and which was transmitted to him for examination. He reports

the object in question to be a liver-fluke, *Distoma hepaticum* —a rare parasite in the human body, and belonging to the liver. The case was a very remarkable one, as being the first instance on record in which an entozoon of this character had been known to enter the alimentary canal.—2 *D*, 1873, 364.

A NEW MUSHROOM MITE.

A new mite, of the genus *Tyroglyphus*, has been discovered in vast numbers in a species of mushroom.—13 *A*, *December* 1, 1873, 455.

EXPLANATION OF THE ALLEGED OCCURRENCE OF THE KING-CRAB IN HOLLAND.

In view of its supposed restriction to North America, much astonishment was excited some time since by the discovery on the coast of Holland of specimens of the American horseshoe, or king-crab. More recently, however, the problem has been solved by a communication in the *Zoologist*, by Mr. W. A. Lloyd, who remarks that in 1860 numbers of these crabs were imported alive into Hamburg, and sold about the streets, and that many were purchased and kept in aquaria and elsewhere. On one occasion, a few years later, a large number were shipped from New York to Hamburg, and the market was glutted thereby. With much tender-heartedness Mr. Lloyd, who was then director of the great aquarium of Hamburg, in preference to allowing this great number to die, took occasion to have them thrown into the sea off the island of Heligoland, this taking place in August, 1866. Whether the animals captured are those originally introduced in this summary manner, or their descendants, is not known, but there is no good reason why the species may not hold its own in these seas, and in time become as abundant as they are on the American coast.—*Zoologist*, *February*, 1874, 3845.

GREEF'S NEW AMŒBOID.

Dr. Greef has lately published an elaborate account of the amœboid fresh-water organism, of which brief mention was made by him not long ago, under the name of *Pelobius*. As, however, this term was previously appropriated in entomology, he now calls this object *Pelomyxa palustris*. It was first noticed by him in the vicinity of Bonn and of Marburg, devel-

oping very rapidly in spring and the beginning of summer, covering the upper layers of mud in large masses, and consisting of an aggregation of little grayish bodies of from one to two millimeters in diameter, with others still more minute intermixed. Under the microscope, the *Pelomyxa*, when contracted, presents a spherical and ovoid or lenticular shape, composed of protoplasm, in which two different layers can be distinguished, one external and the other internal. The outer, or pure protoplasm, is hyaline, and more viscous than the interior. It is full of vesicles, projecting above the surface of the mass, and sometimes lobed or digitated, into which the internal surface penetrates as into a sac. These prolongations break or run together in the amœboid movements which the *Pelomyxa* carries on.

Further details in reference to this animal are too technical to be here reproduced. The conclusion to which Dr. Greef comes, in regard to its affinities, is that it is a multicellular organism, constituting the representative of a group of amœboid objects with multiple nuclei, belonging to the class of *Rhizopods*, and especially allied to several kinds of *Myxomycetes*.—1 *F*, *December* 15, 1873, 361.

NEW FOSSIL SPIDER.

Among other recent interesting announcements is that by Mr. O. Harger of the discovery in the coal measures of Illinois of a fossil spider, to which the name *Arthrolycosa antiqua* has been applied.

SUCCESS OF THE NAPLES ZOOLOGICAL STATION.

Mr. E. Ray Lankester writes from Naples to announce the complete success of the zoological station and aquarium established by Dr. Dohrn, the resources of which are now utilized by a large number of specialists and students in various branches of natural history. The well-known variety of animal life in the Mediterranean permits the marine aquaria to be densely stocked with the most curious objects; and their examination is not simply a passing amusement, but a means of making important discoveries in regard to their natural history.

The expense of erecting the establishment has been borne by Dr. Dohrn; the means of keeping it up, however, are to

be derived from the rent of tables, either permanently or year by year. Several foreign governments have engaged some of these tables, as have also several of the foreign universities, Cambridge among the number.

According to Mr. Lankester, the principal work now being done at the station relates to the history of the development of animals, the embryology of both fishes and marine invertebrates receiving due attention.

ZOOLOGICAL GARDEN OF HAMBURG.

The eleventh report of the Zoological Society of Hamburg, presented to the members on the 16th of July, 1873, gives a gratifying picture of their success in establishing a first-class zoological garden. That city at present has a population of about 236,000, from which the support of the garden is almost entirely derived.

The endowment of the society consists mainly in the proceeds from life memberships, that for a single person costing $90, for families from $135 to $180, according to the number of persons composing them. The payments for life memberships in ten years amounted to $225,000, in addition to which $25,000 were received as presents, making $250,000 as the entire fund.

According to the report referred to, the entrance fees, sales of surplus animals, rent of restaurant, etc., amounted in the ten years to $475,000, the running expenses being $340,000, leaving a surplus of $135,000.

The number of visitors during ten years was 2,855,780, the average daily receipts amounting for the ten years to $136; and as the daily running expenses were $93, there remained a daily surplus of $43.

The society does not attempt to make a dividend among the stockholders, the surplus being applied entirely to the purchase of animals, the enlargement of the buildings, and the general expenses; and, even after this is provided for, there is a small balance, which is carried to the general account.

During the year 1872 there were 253,820 paying visitors, of whom 221,165 were on days when the rates were reduced, and 77,261 were to the aquarium, for which a separate charge was made, the average number per day being 967. There were also 2691 annual subscribers.

The number of animals on exhibition embraced 295 mammals, of 143 species, and 1115 birds, of 282 species. Since its first establishment there have been exhibited 286 species of mammals, and 622 of birds, besides a considerable number of reptiles and fishes not enumerated in the catalogue.

There is no reason to believe that zoological gardens in Europe have more visitors, in proportion to the population, than they would have in the United States; and the statistics here presented furnish a decided encouragement to those who are interested in the organization of similar establishments in American cities. Such places as Boston, New York, Philadelphia, Baltimore, Cincinnati, Chicago, etc., may reasonably anticipate a sufficient number of visitors to warrant the erection of a first-class zoological garden, with entire assurance that the expenses will be fully met, even if great profits are not obtainable. In such a place, however, as New York, there can be no question as to a pecuniary profit. In the Zoological Garden of London the annual income in the way of fees from visitors, etc., amounts to considerably over $100,000, a sum sufficient to meet all the cost of sustaining and exhibiting this unrivaled collection of living objects.—*Report.*

ZOOLOGICAL STATIONS ON THE COAST OF FRANCE.

The zoological station of Roscoff, on the coast of France, as established by Professor Lacaze-Duthiers, has become classical in consequence of the numerous researches prosecuted there, and published to the world, in large part, in the zoological journal of that author. At a late meeting of the French Scientific Association, M. Giard, in referring to the existence of the three marine zoological stations of Concarneau, Marseilles, and Roscoff, gives an account of one lately established by him at Wimereux, making four now under the auspices of French specialists.

Concarneau is well known as the scene of the researches of Professor Coste, of Gerbe, and of Pouchet, while the work at Marseilles has been principally by Lespes and Marion. These places, with Roscoff, according to Giard, are too distant from the north of France to be of any service to naturalists in that neighborhood, or to those who may wish to study the more northern species; and he entered upon a critical

investigation of the various localities, especially in search of one that, while furnishing facilities in the way of water, and at the same time not too near any watering-place, is readily accessible by rail. All these advantages he finds at Wimereux, a station not far from Boulogne, connected with it by railway, and but three hours from the city of Lille. He has, therefore, with considerable effort, secured the means of fitting up a building placed at his command for the purpose, at an expense of about $600, and a large amount of work has already been executed at the new station.—8 *B*, *September* 5, 1874, 217.

THE FAUNA OF NEW ZEALAND.

In a paper upon the geographical relations of the New Zealand fauna, Captain Hutton, a well-known naturalist of that country, attempts to show that this is the remainder of a continental fauna, and that there was one epoch during which South America, New Zealand, Australia, and South Africa were all connected, though not at the same time; also, that New Zealand became isolated before the spread of the mammals, and has never since then been completely submerged. Subsidence next followed, and the evidence then points to a second continent, stretching from New Zealand to Lord Howe Island and New Caledonia, and extending into Polynesia for an unknown distance, but certainly not so far as the Sandwich Islands. Subsidence again followed, and New Zealand was reduced for a long time to a number of islands, upon many of which the moa lived. This was followed by an elevation; these islands became connected, and a large island existed disconnected from Polynesia. This was once more followed by subsidence, and the geography of New Zealand assumed somewhat of its present character. —13 *A*, *September* 15, 1873, 352.

DEEP-WATER FAUNA OF LAKE GENEVA.

Dr. Forell has lately been prosecuting a careful inquiry into the deep-water fauna of Lake Geneva, and has obtained some interesting results which are worthy of being placed on record. It was ascertained that the mud at the bottom of the lake, at a depth of about 100 feet and upward, is every where of extreme fineness, and of a clayey, calcareous nature, sufficiently

plastic to serve for modeling purposes. A section of this reveals, first, an upper layer three to four centimeters thick, bright and yellowish, and formed of mineral mud, with the remains of dead and of living animals. Next comes a bluish layer, about one centimeter in thickness; then a bluish, argillaceous, rather plastic and dense stratum, which is continued indefinitely downward.

The fauna of the bottom appeared to reside entirely in the upper layer, and was investigated by two different methods. The first consisted in allowing the mud to remain in a flat dish, full of water, so that the living animals might come out and swim about and be examined. Then, after a few days, the mud was dried, when various shells came to the surface and made their tracks; and, finally, by scraping the surface, different worms were secured. In this way it was ascertained that the mud is very rich in living animals, the number being estimated at about one hundred to the square meter of mud.

Another method consisted in washing out the mud, leaving the animal matter behind, which gave the dead animal matter, especially the shells, mollusks, crustaceans, etc.

Dr. Forell estimates the number of shells, entomostracans, etc., at from five to ten thousand per quart of the mud. This abundance of organic remains may possibly explain the richness in nitrogenous and phosphatic matters of a certain class of marls employed for agricultural purposes. As far as the vegetable life was concerned, no growing plants were found beyond a depth of about eighty feet, although some violet algæ and numerous diatoms were met with.

Among the conclusions reached by Dr. Forell in his inquiries are these: that in the Swiss lakes there are two distinct faunas on the bottom—a littoral fauna, or that of the banks, extending to a depth of forty-five to sixty-five feet, and the deep-water fauna, reaching to 900 feet and more; there is furthermore a pelagic fauna, consisting, of course, of fishes, crustaceans, etc., that change their position in the water. All the forms of the deep-water fauna are analogous to that of the shore, but not exclusively of the same species. Differences were met with of considerable importance; thus in some places there were beds of the egg-shells and carapaces of crustaceans.—13 *B*, *November* 15, 1873, 382.

THE CAVE FAUNA OF THE UNITED STATES.

A paper was read at the Hartford meeting of the American Association, by Professor Packard, upon the cave fauna of the United States, which embraced the results of an examination upon which he has been recently engaged. These exhibit a uniformity in the distribution of cave life throughout the entire region of the West much greater than might have been expected.

Of plant life three forms of low fungoid growths occurred in the Mammoth and other caves on old pieces of stick, but not in sufficient abundance to serve as a basis for the animal life of the caves, which was nearly all carnivorous, except in the case of the poduras and snails, which probably thrived on the decaying fragments of wood artificially introduced into the caves.

Professor Packard was not able to determine what constituted the food of the most abundant insect of the caves—the wingless grasshopper. Of *Protozoa*, six forms were found in water taken from Willie's Spring, about half a mile from the mouth of Mammoth Cave. Two species of *Helix* and one of *Pupa* were seen, although both may have been introduced by man. A Planarian worm was met with about a quarter of an inch long. The common earth-worm occurs in all the caves. Blind craw-fish, spiders, beetles, etc., and fishes were among the animals observed. These researches of Dr. Packard, in addition to those previously detected, bring the number of cave species up to about one hundred.

FOSSIL VERTEBRATES IN OHIO.

Ohio has of late years been quite prolific in discoveries of interesting fossil vertebrates, and, among others, those of the mastodon, of which the following are recorded since the commencement of the Geological Survey in 1869: the upper jaw and skull, in Pike County; portions not yet exhumed, near New Holland, Fayette County, found in a marsh, and partly exposed; two tusks, near Germantown, in Montgomery County; a tooth, near Kenton, in Hardin County; almost a complete skeleton, in St. Johns; a femur, bones of the feet, and ribs, near Woodstock, Champaign County; and one reported near Greenville, in Darke County.

We have already referred to the discovery by Mr. J. H. Klippart of ten complete skeletons of the fossil peccary; and while excavating for an extension of the walls of the penitentiary at Columbus last summer, the lower jaw of a fossil horse was found. Of this there were four teeth, and, according to Mr. Klippart, some of them were three and a half inches long, and about an inch square. This jaw was found about half a mile from the locality that supplied the peccaries' skeletons (*Platygonus compressus*), and in the same geological drift period.

THE VELOCITY OF NERVOUS TRANSMISSION.

Exner has investigated the time that elapses between the reception of an impression on the brain and the voluntary movement made by the body in response thereto. This, which he calls the reaction time, amounts to one ninth of a second in the case where the eye receives and the hand answers to the impression, and the time increases with increasing intensity of the exciting cause producing the impression. In order to investigate the similar question with reference to involuntary movements of the body, he experiments upon the winking of the eyelids. His observations are made by attaching a self-recording apparatus to one of the upper eyelids, and he obtains from these investigations the reflex time—that is to say, the time in which the involuntary action follows the reception of any impression. Exner concludes that the reflex time is not a constant, but is smaller in the case of strong exciting causes, as is also the case with the reaction time; and, again, that the magnitude of the reflex time, in general, differs only very slightly from the reaction time.—19 *C*, 1874, 155.

ACTION OF THE POISON OF EGYPTIAN SERPENTS.

A paper was read by Professor Panceri, before the Egyptian Institute of Cairo, relating to his experiments on the action of the poison of Egyptian serpents, in which he presented the conclusion that two animals only, the ichneumon and *Mephitis libyca*, are able to resist large doses of the poison of the naja and the ceraste, so that in ordinary cases they may be considered as invulnerable to these serpents. These results are thought possibly to account for the veneration in

which the ichneumon is held by the ancient Egyptians.—13 *A, May* 16, 1874, 545.

ORIGIN AND FORMATION OF DOUBLE MONSTERS.

An elaborate paper by Dareste upon the origin and mode of formation of double monsters discusses the subject in all its details. He comes to the conclusion that these, among the vertebrate animals, always result from the union, or more or less complete confusion, of two embryos produced upon a single cicatricule.—*Duthiers' Archives*, 1874, I., 118.

HEIGHT OF THE HUMAN SPECIES.

M. Silberman shows that the average height of the male and female population of France, taken in a certain position which he names the "geometric," is 1.600040 meters, or two meters if, in the same position, the hands are comfortably extended over the head. Two individuals laid lengthwise, with fingers touching, will thus measure four meters; and this he terms the base of the harmonic proportions of the human race. Thus this harmonic base is four times one meter, just as the meridian is four times ten million meters, and the relation of the two integers is as 1 to 10,000,000. From these considerations he draws proof of the equality of the sexes, as they exhibit woman, not as a complement to the male portion of the race, but as constituting normally, and by right, half of the human family. M. Silberman arrives at the conclusion, as the result of his various investigations and studies, that the average height of the human race has remained unchanged since the Chaldean epoch, 4000 years ago.

THE THEORY OF ERRORS OF OBSERVATION.

Mr. C. S. Peirce, in an interesting article on the laws of errors of observation, and the nature of the so-called personal equation, gives the results of some experiments made upon an entirely untrained observer, a young man about eighteen years of age, who had had no previous experience whatever in observations. He was required to answer a signal consisting of a sharp sound like a rap, his answer being made by tapping upon a telegraph operator's key nicely adjusted. Both the original rap and the observer's tap were recorded by means of a delicate chromoscope, and five hundred ob-

servations were made on every week-day during a month. It was found that on the first day the observations were scattered through a very large range of error, the difference in time between the records of the event and of the observation varying in fact between the extreme values from 0.16 to 0.98 of a second. The personal equation proper on the second day was between 0.2 and 0.3 of a second, and from that time it steadily decreased until it amounted only to one seventh of a second; it then gradually increased until the twelfth day, when it amounted to 0.22 of a second. While this variation in personal equation occurred, the range of errors or discordances was constantly decreasing, until on the twenty-fourth day the probable error of the result does not exceed one eightieth of a second. This is considered to clearly demonstrate the value of such practice in training the nerves for observation; and he recommends that transit observers be kept in constant training by means of similar observation of an artificial event, which can be repeated with ease and rapidity, it not being essential, he thinks, that those observations should very closely imitate the transit of a star over the wires of a telescope, inasmuch as it is the general condition of the nerves which it is important to keep in training more than any thing peculiar to this or that kind of observation.—*Report Supt. Coast Survey*, 1870, 224.

THE EARLY RACES OF MANKIND IN IRELAND.

Sir William Wilde made a communication before the British Association upon the early races of mankind in Ireland, and ascribes the greater bulk of the Keltic population to the "Firbolgs," the "Tuatha-de-Dannans," and the "Milesians." The *Firbolgs* were described as a pastoral and agricultural people, small in stature, oval-headed, straight-haired, and of swarthy complexion; this associated with blue-gray eyes and dark eye-lashes. These are supposed to have been the first builders of the earthen forts, and to have buried their dead without cremation, but erecting tumuli or cromlechs as their monuments. They, with the fair-skinned *Dannans*, constitute the bulk of the farm-laborers who migrate to England during the harvest season.

The *Tuatha-de-Dannans* are described as large-sized, fair-skinned, and round-headed. They were warlike, musical, and

skilled in the working and smelting of metals, and accomplished as masons. They are believed to have built the great stone cohirs and caves in Ireland, and to have decorated the stones of their sepulchres with carved ornamentation. To these a Scandinavian origin has been attributed by some authorities. The first two of these races were in conflict with the third, the *Milesian*, who are described as having been a brave, warlike, chivalrous, proud people, skilled in navigation. Most of the Irish families, especially those having the prefix O', claim to have descended from the old Milesian chiefs. All these races are said to have spoken a common language, and may have been derived from one Keltic stock.—15 *A*, *August* 29, 1874, 280.

EXHIBITION OF BRITISH ETHNOLOGY.

Among other features proposed for the annual international exhibitions by the British authorities is a series of objects illustrating the ethnology and geography of the various races and parts of the British empire, and it is intended to pursue the work systematically, in the hope of ultimately forming a great national museum of the empire, to be arranged for the present in the galleries of the Royal Albert Hall. The commissioners remark, in a circular just issued by them, that many portions of the empire are inhabited by aboriginal races, most of which are undergoing rapid changes, and some of which are disappearing altogether. These races are fast losing their primitive characteristics and distinguishing traits. The collections should embrace life-size and other figures representing the aboriginal inhabitants in their ordinary and gala costumes; models of their dwellings; samples of their domestic utensils, idols, weapons of war, boats, and canoes; agricultural, musical, and manufacturing instruments and implements; samples of their industries; and, in general, all objects tending to show their present and ethnological position and their state of civilization.

It is proposed to receive for the exhibition of 1874 any suitable collections, which will be grouped and classified hereafter in their strict ethnological and geographical relations. As, however, there is at present great public interest in the various tribes inhabiting the west coast of Africa, including the Ashantees, with whom Great Britain is at war,

all objects relating to the Ashantees, Fantees, Dahomeys, Houssas, and the neighboring tribes, are especially desired. The Indian empire, the Eastern Archipelago, and the islands of the southern hemisphere are also able to afford abundant and valuable materials for the proposed museum, of which it is believed that the nucleus can be formed at once from materials in private collections.

Her Majesty's commissioners confidently appeal to the civil, military, and naval officers of the British service throughout the Queen's dominions to assist them in these collections, and they have secured the services of eminent gentlemen to advise them from time to time in giving effect to these intentions. It is requested that offers of gifts and loans of objects should be made known at once to the secretary of her Majesty's Commissioners, Upper Kensington Gore, London, S. W.

It may not be known that precisely such a collection as this, for America, has been undertaken by the Smithsonian Institution, as part of the National Museum at Washington, the preparation of cases in a hall two hundred feet by fifty for this purpose being nearly completed. We are informed that when the specimens now actually in the National Museum are suitably arranged and displayed, the result will be an exhibition of the most unique and striking character, both on account of its magnitude and the variety of its objects. Among what we may call the monographic collections already on hand, according to the report of the Smithsonian Institution, are the Greenland Esquimaux, the Esquimaux of the arctic coast of North America, between the mouth of the Mackenzie and the Coppermine, the Tschuktchi of Northeastern Siberia, the inhabitants of the Aleutian Islands (both modern and prehistoric), the Indians of Sitka, those of Queen Charlotte's Island, of British Columbia and Puget Sound, the various tribes on the Missouri, and especially the Snake Indians and the Pi-Utes of the Colorado River. This latter collection, made by Major Powell, is exhaustive in its nature, and of the most wonderful interest, as belonging to a tribe still using the dresses and other appliances of a century ago, and among whom the stone age has still its full development. Among the collections referred to are knives, scrapers, and stone implements in great variety, all properly mounted on handles, and throwing great light upon the hitherto unsug-

gested applications of similar objects dug up in various parts of the world.

DISCOVERY OF A HUMAN BONE IN A CAVE IN YORKSHIRE.

The discovery of a human fibula bone in the remains of the Victoria Cave, near Settle, in Yorkshire, is justly considered as a very important scientific fact, as there seems to be no doubt of its human origin, or that it is of the same age as the molars of *Elephas antiquus* and the bones of the hyena, with which they are associated. Mr. Tiddeman maintains that it was deposited in preglacial times, before the great ice sheet overspread the country.—15 *A*, *September* 5, 1874, 317.

ETHNOLOGICAL INQUIRIES BY THE GERMAN TRANSIT EXPEDITION.

As might have been expected, nearly all the European expeditions for the observation of the transit of Venus have received instructions to make collections and observations in other branches of science than that of astronomy; and the Germans being especially interested in the subject of ethnology, very elaborate instructions for observation have been prepared by Professor Virchow. In these attention is particularly invited to the investigation of prehistoric remains among the Polynesian and Melanesian Islands, and in regard to the distribution of domestic animals therein, the determination of the boundaries between the Negritos, the Papuas, and the Australians, as also any mixture with them of the Malays. Inquiries are to be made as to the distribution of sundry peculiarities in the arts, such as that of manufacturing vessels of clay, and the extent of the use of certain arms. Particular attention is called likewise to the articles of food, and the degree to which animal substances enter as nutriment; also where salt is dispensed with, and the amount of use of human flesh as compared with other materials.—30 *C*, *July*, 1874, 56.

FOOTPRINTS IN SOLID ROCK.

Considerable interest has been excited from time to time by announcements of the discovery of supposed human footmarks in the solid rock; the latest being an account in the *Nashville Union*, of August 2, of their occurrence at the nar-

rows of Harpeth. It may not be amiss to state here that there can be no question of the artificial origin of all these marks, the similitude of the human foot being a favorite form of picture-writing among the aborigines. Several well-executed specimens are in the National Museum at Washington, and others are to be found elsewhere. They are usually executed in limestone, slate, or sandstone, and are of very rude workmanship, notwithstanding all encomiums upon their marvelous perfection. On close examination they will be found cut through the lamination of the rock, instead of indenting it, as would be the case if produced by a naked foot traversing a surface in a plastic condition.

ANCIENT STONE FORT IN INDIANA.

Professor Cox gives an interesting account of an ancient stone fort in Indiana, in which a break in the natural wall of an ancient fortification was protected by an artificial wall seventy-five feet in height, made by laying up loose stone, mason fashion, but without mortar. The base for sixty-five feet in height follows the slope of the hills, and then rises ten feet vertically. Around the southern terminus of the point there is an artificial stone wall ten feet high, connecting the two natural walls, of Niagara limestone, and forming a complete barrier to the approach of foes. Numerous mounds of earth occur inside the wall, and within the line of these there is dug a ditch four feet deep and twenty feet wide, which receives the drainage from the crown of the hill. This interesting prehistoric work is situated fourteen miles above the falls of the Ohio River, in Clark County, Indiana.

DALL'S ETHNOLOGICAL EXPLORATIONS IN ALASKA.

In 1872 Mr. William H. Dall made some interesting discoveries of prehistoric remains in a cave on Amaknak Island, situated in Captain's Bay, Unalashka, which he supposed exhausted the subject. In 1873, however, he found that he had left undisturbed a still lower stratum, and finally cleaned out the entire cave down to the bed rock. He ascertained that the whole interior of the cave had been painted over with a red pigment, or chalky ore of iron, above which was a bed of organic mould, about two feet in its greatest depth, in which were found three skeletons, surrounded by a rough

sort of sarcophagus built of the jaws and ribs of whales, and around them were a large number of implements, especially of stone knives. This was covered in turn by a layer, six inches or less in thickness, of refuse material, the remains of repasts on marine animals, shell-fish, fish, and echini. Scattered irregularly over this were broken and worn implements of quite a different character from those found with the dead; and the whole indicated that this was only a resting-place of parties who used it temporarily while waiting an opportunity to cross the surf to the adjacent island. It was down to this lower stratum that the labors of the previous season had extended, but without disturbing it.

A stratum of this latter portion was covered by a bed of shingle, evidently introduced by water, and supposed to be the actual bottom of the deposit. Mr. Dall is of the opinion that the skeletons found here are the oldest yet discovered in the Aleutian region, although not approaching in antiquity those discovered on Table Mountain or the Neanderthal. He thinks the cave was first used as a burial-place, the mould over the three skeletons having accumulated by the decay of animal matter and of rubbish; and that the *débris* from the repasts of occasional visitors had been gathering for a great many years. An unusually high tide or storm probably brought in the shingle from the adjacent sea-beach, and after this the cave was again used as a deposit for the dead. Nothing was discovered indicating in any way that the place had been used or visited by the white races.

The total number of crania obtained by Mr. Dall amounted to thirty-six, besides many hundred implements of bone, ivory, and stone, and many carvings of wood and other objects, presenting evidence of the existence of large and flourishing communities numbering thousands of inhabitants where now none, or only remnants of population, exist.

Underneath the old villages were found still more ancient kitchen heaps of echini, fish-bones, and edible shell-fish, many feet in thickness, the age and time taken in forming them scarcely to be approximated or counted even in centuries. Only in the upper strata were seen the indications of progress in hunting and fishing, afterward so notable that even the sperm-whale succumbed to the attacks of these hardy canoe-men. Their progenitors were content to pick echini from the shore

and mussels from the rocks, and hardly any implements could be found in the refuse of their repasts—the accumulation of centuries.

After them large villages of solidly constructed houses rose; and probably at the height of their progress and numerical increase the almost equally barbarous Russians of Siberia fell upon them, and nearly swept them from the face of the earth.

TRADE AMONG THE ABORIGINES.

In illustration of the trade which was formerly carried on between the Indians of the interior and those of the coast, we are informed that in an Indian mound in Ohio, lately explored by Mr. William Anderson, a correspondent of the Smithsonian Institution, there were found around the neck of a human skeleton the remains of what was probably a necklace of shells. These were submitted to the examination of Mr. John H. Redfield, of Philadelphia, who decided that they were one of the forms of *Marginella apicina*, Menke—a species which occurs at Tampa Bay, in Florida, on the Atlantic coast of the peninsula, but not noted elsewhere. Even if these occur on the coast of the Gulf of Mexico generally, this shows that such objects were either carried by the collectors to a great distance, or traded for by their subsequent possessor. A fossil species closely allied to this (*M. limatula*, Conrad) occurs as far north as Wilmington, North Carolina.

ETHNOLOGY OF ANCIENT EGYPT.

Professor Owen, in a recent paper on the ethnology of Egypt, combines the results lately attained by Mariette-Bey with those previously recorded, and concludes that three distinct types of portrait sculptures are to be found in the statues and tombs of the ancient Egyptians.

1. The primal Egyptian, bearing no trace of the negro or Arab, but more nearly matched by a high European physiognomy.
2. The type of the conquering race of Shepherd Kings.
3. The Nubian Egyptian, typified in the bass-relief figure of Cleopatra.

In conclusion, Professor Owen draws a graphic picture of the high state of civilization attained by the primal Egyptian

race, whose exquisite works, done six thousand years ago, are now rendered accessible to man.—12 *A*, X., 138.

KJOEKKENMÖDDING IN NORWAY.

Zeigler has lately discovered near Drontheim, in Norway, what is said to be the first illustration of the kjoekkenmödding (or shell heaps) yet found in that country, this consisting of a large mass of broken animal bones and shells mixed with a little earth. In the centre of this was a dark layer, indicating traces of fire, in the form of bits of charcoal, etc.—30 *C*, *January*, 1874, 5.

FURTHER EXPLORATIONS BY DI CESNOLA.

Since his return to Cyprus, General Di Cesnola, the United States consul, has resumed his archæological researches, the magnificent results of which, for previous years, are in the possession of the Metropolitan Museum of Art, in New York. In the neighborhood of Salamis he has already found several sculptures of the Græco-Roman period. He has also discovered some interesting inscribed objects and a cave containing a large quantity of petrified human bones.—15 *A*, *May* 9, 1874, 630.

ARCHÆOLOGICAL SURVEY OF BRITISH INDIA.

Professor J. Burgess has lately been appointed by the East Indian government archæological surveyor and reporter to the government for Western India. Mr. Burgess has made a large number of collections for a work illustrative of Ajanta and other cave-temples on the frontiers of the Nizam's territories, and expects to resume his researches with a view of securing further material for this work.—*Trübner's American and Oriental Literary Record*, 1874, VIII., 189.

THE SPECIES OF AMERICAN SQUIRRELS.

Mr. J. A. Allen, well known as one of the most accomplished and thorough of American zoologists, has lately published a synopsis of the general results obtained by him from an investigation of the American *Sciuridæ*, or mammals belonging to the squirrel group, including the squirrels proper, the flying-squirrels, ground-squirrels, marmots, etc. As the result of his inquiries, based upon the immense amount and variety of

material in the National Museum at Washington, he has occasion to reduce the number of species still lower than that allowed by Professor Baird in his monographs of the same forms, finding that many of those which have hitherto been considered as species are in reality merely climatic or geographical races, several of which are referable to a common type.

A striking generalization obtained in his investigations has reference to the increasing intensity of color of the species in proceeding from the north southward, this being very evident in the fox-squirrel of the Mississippi Basin, the belly of which in the northern part of its range is almost white, while in specimens from Lower Louisiana it is reddish-fulvous, or a deep orange. Equally decided differences exist in specimens of the same species as they proceed from east to west.

Mr. Allen now considers that we have at least five more or less well-marked areas characterized by certain peculiarities of color variation in mammals and birds, as well as by a close relation between the areas, the prevalent tendencies of change of color, and the amount of aqueous precipitation. The first of these regions is that of the Atlantic slope, which includes not only the country east of the Alleghanies, but a large part of the British possessions, extending westward as far as Fort Simpson, and northward and westward to Alaska, including, apparently, all that territory north of the Alaskan Mountains, and having an annual rain-fall of about thirty-five to forty-five inches. This region, in view of its great extent, he selects as representing the average or normal type of color, the variation in other regions being in the direction of intensity.

The second region embraces the Mississippi Valley, or, more properly, the Mississippi Basin, and is termed the *Mississippi Region.* Here the annual rain-fall reaches forty-five to fifty-five inches, and sometimes more. In this region the tendency is to an increase of fulvous and rufous tints, these reaching their maximum in the limited area of greatest humidity, although a general increase of color is more or less characteristic of the region.

The central portion of the Rocky Mountains forms the third region, to be called the *Colorado Region*, as including the greater part of that territory within its limits. Here

the general tendency is to an increase of intensity of colors, as compared with the region west of it, with a development of rufous and fulvous tints. The humidity here is less than that in either of the other regions named, the rain-fall being only from twenty-four to thirty inches.

The fourth area Mr. Allen calls the *Campestrian Region*, and includes the arid plains and deserts of the continent, containing not only the "great plains," so called, but the plains of Utah, Nevada, Western Colorado, New Mexico, Arizona, and southwest to Lower California. Here the rain-fall ranges from three inches to twenty, being below fifteen generally. Here a general paleness of color is the distinctive feature.

The fifth region, called the *Columbian Region*, begins on the Pacific coast at about the fortieth parallel, and embraces a comparatively narrow belt to Sitka. Its peculiarities are most strongly developed west of the Cascade Range north of 45°, and prevail eastward nearly to the main chain of the Rocky Mountains. The average rain-fall is from fifty-five to sixty-five inches. The prevalent tendency in color is to dusky and fuscous rather than rufous tints.

Other subdivisions of a similar character Mr. Allen thinks may be desirable, and may need to be made hereafter, especially for the southern half of Florida, which is characterized by excessive humidity and a subtropical intensity of color; and it may be necessary to recognize as a distinct district the almost rainless portions of the *Campestrian Region*.

Mr. Allen in this communication refers again to the relation between color and humidity previously enunciated by him, remarking that the best mode of expressing it is to say that a decrease of humidity is accompanied by the decrease of intensity of color, this evidently resulting from exposure to the bleaching effect of intense sunlight and a dry, often intensely heated, atmosphere. He refers to the condition of *melanism* as a race characteristic in mammals, and confirms the generalization of Professor Baird that but few mammals possess this in a specific form, and that where it occurs in such groups as the squirrels, the wolves, cats, etc., the individual must be considered as a melanistic form of some race the normal color of which is different, generally fulvous or rufous.

Mr. Allen's paper embraces a list of the species of North American *Sciuridæ* which he considers permanent, and among the true squirrels he allows but five that are permanent where Audubon gives twenty-four. He, however, recognizes in addition seven geographical varieties, making the whole number of permanently distinct forms twelve. Of flying-squirrels he allows but *one species;* of the genus *Tamias*, or the ground-squirrels, he gives *three;* of the *Spermophilus*, *eleven;* of the prairie-dogs, *two;* and of the true marmots, *three*—making twenty species in all.—*Proc. Bost. Nat. Hist. Soc.*, XVI, 1874.

RELATIONSHIP OF AMERICAN DEER TO THEIR BRITISH ANALOGUES.

The precise relationships of certain species of American deer to European analogues—the moose, the reindeer, and the elk especially—have been the subject of critical consideration on the part of naturalists for many years past, some maintaining that they are identical, and others that they are distinct. None has given the matter more attention than Judge Caton, of Illinois, who for many years has had in his large park near his residence at Ottawa specimens of nearly all the American species, where he has carefully studied their habits.

Quite recently Judge Caton visited the North of Europe for the purpose of examining the Old World forms in life, and has satisfied himself, from careful study, of the absolute identity of the moose and the caribou of the two continents, and of the very close relationship between the American elk and the European stag. One character of much importance in the deer consists in the presence and shape, or entire absence, of a peculiar gland on the metatarsus of the hind-leg, this being indicated, if present, by a tuft of hair of a particular shape, and varying with the species. The American representatives of the moose and caribou do not possess such a gland; and as Dr. John Edward Gray asserts its existence in the European species, Judge Caton at one time inferred a specific distinction. He now finds, however, that equally with the American they are destitute of the gland, and that there is absolutely no point in which they can be separated.

In regard to the relationship between the European stag and the American elk, he finds the principal difference to be in the smaller size of the former. Fossil remains, however,

show a size like our variety, with antlers equally large, and with all the distinguishing peculiarities, even to the occasional presence of a snag on the brow antler, which occurs in about five per cent. of our elk; but never, so far as Judge Caton could learn, in the European animal of modern times. The two also inbreed perfectly well in European forests, with fertile progeny.

This entire subject will probably be thoroughly elucidated by Judge Caton in an exhaustive work on the American *Cervidæ*, upon which he has been engaged for some years past.

THE CHARACTERS AND RELATIONS OF THE HYOPOTAMIDÆ.

The first part of a very important memoir "on the Osteology of the Hyopotamidæ," by Dr. W. Kowalevsky, of Russia, has been lately published in the "Philosophical Transactions of the Royal Society of London" (vol. clxiii., p. 19–94, 1874), and is illustrated by six plates (pl. 35–40). A flood of light is thrown upon the group in question, which had, it seems, been previously much misunderstood. After some well-deserved criticisms on the looseness and irrelevancy of descriptions of some of his predecessors, the author proceeds with the description of the long bones (scapula, humerus, ulna and radius, femur, tibia and fibula, and foot bones), to which this first part is restricted. His researches confirm the naturalness of the division of the typical ungulate quadrupeds into two sub-orders, distinguished by the structure of the foot, *i.e.*, (1) Paridigitata, or Artiodactyla, and (2) Imparidigitata, or Perissodactyla; and so decisive is the evidence afforded by the relations of the bones of the feet that it is remarked that "we may very often know most of the long bones of the skeleton —the scapula, the humerus, the antibrachium, the tibia, and fibula of a fossil ungulate—without being able to determine quite certainly the natural series to which it belonged; nay, even more, we may discover the skull and the complete dentition without being made much wiser by it. The history of paleontology swarms with such examples; but the discovery of a single carpal or tarsal bone very often clears the whole question by showing in the most unmistakable manner the true affinities of a fossil form." Such considerations induced Dr. Kowalevsky to enter into a detailed examination of the

parts in question, the material for which he found chiefly in the British Museum, and in several collections at Puy, France. He thus found that in the Artiodactyls, numerous as they are in families and species, the similarity is so great that, notwithstanding the diversity which prevails in size and the modifications of other parts, and even of the feet, "we may trace throughout the whole, not only the number and shape of their carpal and tarsal bones, but even each separate facet of these bones, and point it out as clearly in the reduced limb of a land antelope as it is displayed in the complete unreduced limb of the aquatic hippopotamus;" and this similarity, says Dr. Kowalevsky, is so great that "we can not explain it in any other way than by community of descent." The principal modifications in those parts are exhibited, in the progress of reduction of the digits, by the diminution and final disappearance of the trapezium, and the confluence at an early age of the trapezoid and magnum in the carpus, while the common likeness of the bones of the tarsus is still more striking, and the modifications are chiefly in the size of the marginal bones and the coalescence or non-coalescence of cuneiforms. The metacarpals and metatarsals exhibit interesting relations, and adaptive and non-adaptive modifications.

The forms embraced under the common name Hyopotamidæ and Anthracotheriidæ had been considered to be most nearly allied to the hogs and related forms; but the investigations of Dr. Kowalevsky conclusively prove that such is not the case, but that they were true ruminants, and, according to Professor Gill, their allies are quite numerous in this country, and are found in the genera and species combined under the family name Oreodontidæ, the remains of which are so abundant in the miocene and pliocene deposits of the West. The Hyopotamidæ as well as the Oreodontidæ have the canines modified like the incisors, as in ordinary ruminants, and the molar teeth have also the usual crescentiform folds, but they differ in the produced snout and the dentition, and especially the modifications of the premolars. The earliest known representatives of the family have been found in eocene deposits, and during the eocene and miocene epochs they were the most abundant and characteristic of ungulate mammals. They did not survive the latter epoch, and have left no successors. In size they ranged

from that of a rat (as in the case of eocene species) to that of an ass.

SHAD IN THE GULF OF MEXICO.

As a contribution to the history of the occurrence of shad in the waters tributary to the Gulf of Mexico, we may mention that, according to the Montgomery *Advertiser*, several genuine shad were taken in Pigeon Creek during the spring of 1874. This stream empties into the Escambia River, which discharges into the Gulf of Mexico at Pensacola. The occurrence of shad in considerable numbers in other parts of the Escambia River has already been well substantiated.

HISTORY OF THE PACIFIC COAST MARINE MAMMALS.

An exhaustive work on the marine mammals of the North Pacific by Captain C. M. Scammon, of the United States Revenue Service, has just been published by John H. Carmany & Co., San Francisco. It forms a stout quarto volume, with many plates, and contains an exhaustive history of the whales, porpoises, and other cetaceans, together with that of the sea-elephant, sea-lion, sea-otter, the walrus, etc., all accurately figured and described.

A specially important section of the volume is that upon the American whale-fishery, giving an account of its origin, extent, mode of prosecution, its progress and present condition, with a full description of all the apparatus used in the capture and utilization of the cetaceans, and the incidents of a whaling life.

In an appendix is a systematic account and catalogue of the cetaceans of the North Pacific by Mr. Dall, a glossary of words and phrases used by whalemen, and a list of stores and outfits. The press-work and make-up of the book, as well as the illustrations, are of the first class, and would do credit to the best of the establishments in the East.

The value of this book consists in its having been prepared by one who was himself in the whaling business for many years, which he left during the war to become an officer of the revenue service; and, although he has depended to some extent upon others for the scientific technicalities, the peculiar value of the book is entirely due to himself.

As an exhaustive treatise, even of a limited field of the

whale-fishery, this book occupies the first rank in the literature of the subject. It will doubtless have a large circulation among the whalemen of Cape Cod and New England generally, since by a reference to it they can renew their experiences, and fight over again their early battles.

DECREASE IN THE EUROPEAN BISON.

It is well known that the living representatives, in Europe, of the European bison, which is closely allied to, if not identical with, the American buffalo, consist at present of a single herd in Lithuania, the property of the Emperor of Russia. Recent reports indicate a gradual decrease in their numbers, with a probability of eventual extermination. It is many years since the number exceeded 1000, and in 1858 it was but 559; in 1861, 541; and in 1872, 528.—3 *C, May* 25, 1874, 420.

EGGS OF THE SILURIDÆ.

It is an interesting fact in the economy of certain fishes, especially of those belonging to the family of the Siluridæ, that the mouth constitutes the nest for hatching the eggs, these to the very limited number of from five to twenty being kept in this cavity, usually that of the male, until they are hatched. They are probably caught up after exclusion and fertilization, and retained. Some of these eggs are half an inch in diameter. The fact of this peculiarity in the case of the genus *Arius* and some of its allies in America has long been known; and Dr. Day announces the same condition in certain Indian species of *Arius* and *Osteogeniosus*.—12 *A, February* 5, 1874, 272.

DISCOVERY OF PUTORIUS NIGRIPES.

Among the new animals described by Audubon and Bachman in their great work on North American quadrupeds was a kind of weasel, named by them *Putorius nigripes*, or black-footed ferret, of which a single specimen came into their possession, constituting apparently a good species.

In the thirty years that have elapsed since the announcement of this discovery diligent search has been made for additional specimens, but in vain; and it was not until recently that a skin was sent to the Smithsonian Institution from the North Platte by Mr. La Munyon, one of its correspond-

ents. He states that they are very rare, but are known to the hunters as living mainly upon the prairie-dogs, and inhabiting their dens, the tracks of the ferrets being often visible in the snow, passing from one hole to another, during the winter.

It is to be hoped that with this hint in regard to the species additional specimens may be forthcoming, and their true character determined. Unfortunately the specimen of Mr. La Munyon was not accompanied by the skull, thus rendering it impossible to determine whether it is a true *Putorius* like the mink, or a *Mustela*, and more allied to the pine-marten, or the so-called "sable" of Northern New York.

AN EGG SIX CENTURIES OLD.

In removing a portion of the town wall of Kaschau, which dates from the twelfth century, a hen's egg was found imbedded in the middle of some fine sand, which filled a cubical space in the solid wall. The shell is yellowish-brown, speckled like a tobacco-leaf, but perfectly preserved. It is conjectured that it was placed there when the wall was built by reason of some superstition; perhaps with the hope of rendering the wall impregnable.—1 *C*, 1873, xxiii., 360.

THE FOSSIL HOG OF AMERICA.

Mr. Klippart, of Ohio, at the recent Hartford meeting of the American Association, gave the details of his discovery of a large number of skeletons of the fossil hog of America, to which brief reference had been previously made by Professor Newberry in his report on the geology of Ohio. These were found while digging the artesian well of the city of Columbus, and were obtained at a depth of from twenty to thirty feet. Several skeletons were complete, and the whole series is one that furnishes the means heretofore wanting for determining the entire osteology of the animal. This hog is the *Platygonus compressus* of Le Conte, and is closely allied to the peccary, although with a longer and very slender snout.

DALL ON THE BIRDS OF ALASKA.

A paper has been published by Mr. Dall on the birds of the Aleutian Islands, especially of that portion of the region

to the west of Unalashka, embracing the result of observations made during 1873 on board the United States Coast Survey vessel the *Yukon*. As might have been expected, the great majority of the species are water birds, particularly *alcadæ*, upon the natural history of which Mr. Dall throws much light, having been the first to collect eggs of several of the species, and to observe their habits during the breeding season.

The land birds on these islands are very few in number, consisting of two kinds of hawks, one owl, one swallow, one wren, five finches, the raven, and the ptarmigan. The total number of species enumerated is forty-five.

LAWRENCE'S BIRDS OF NORTHWESTERN MEXICO.

A paper by Mr. George N. Lawrence upon the birds of Western and Northwestern Mexico is based upon collections made by Messrs. Grayson, Xantus, and Bischoff. Although confined principally to the northwestern corner of Mexico, just south of the line of the United States, the number of species observed amounts to 316. Quite a number of these species proved to be new, and were subsequently described by Mr. Lawrence himself, Professor Baird, and others. The value of the list is much enhanced by selections from notes furnished by Colonel Grayson.

COLLECTION OF BIRDS-OF-PARADISE.

Dr. A. B. Meyer, of Vienna, who has been engaged for several years past in the exploration of New Guinea, and in collecting its rarities of animal life, has lately returned home, bringing, among other interesting objects, a large number of the magnificent birds-of-paradise peculiar to that island, these including quite a number of new species. He offers them for sale at prices varying from $150 to $50 each, either singly or in sets. These birds are the most gorgeously beautiful of the whole feathered tribe, as may be readily seen by an examination of the considerable collection already in the Central Park Museum in New York.

GEOGRAPHICAL DISTRIBUTION OF ASIATIC BIRDS.

An article upon the geographical distribution of Asiatic birds, by Mr. H. J. Elwes, appears in the Proceedings of the

London Zoological Society. This is the first attempt that has been made to determine accurately the number and boundaries of the zoological provinces of that continent, although Dr. Sclater and other eminent writers have sketched out the subject in a general way.

His primary division is into a Palæ-arctic region and an Indo-Malay region, of which the former embraces by far the greater portion of the continent, including, indeed, every thing continental excepting the southern portion, south of China and the Himalaya Mountains.

The Palæ-arctic region is divided into the Siberian or Boreal sub-region, including Siberia and the Amoor lands; the Mongolian sub-region, embracing Thibet, Tartary, Turkistan, and the Caspian Sea, etc.; the Mediterraneo-Persic region, which extends through Europe, and includes the northern coast of the Mediterranean Sea even to the Atlantic Ocean as far north as 45°, the Black Sea, the shores of the Red Sea, Arabia, Persia, Afghanistan, Beloochistan, etc.

The Indo-Malay region is divided into the Himalo-Chinese sub-region, which includes the greater portion of Southern China, Burmah, Siam, and the mountainous portions of Hindustan, Ceylon, Malaya, and Sumatra.

The Malayan region includes the lowlands of Malaya, Sumatra, and Borneo.

It is a remarkable fact, as compared with North America, that the zoological provinces of Asia are bounded by parallels of latitude, and extend continuously from east to west, instead of being bounded by degrees of longitude. This is probably mainly owing to the general direction of the great mountain regions, especially that of the Himalayas, from east to west instead of north and south.—*Proc. Zool. Soc. London.*

SUGGESTED INTRODUCTION OF THE ROOK INTO THE UNITED STATES.

Rev. F. O. Morris, in a letter addressed to the London *Times* upon the subject of the threatened invasion of Great Britain by the Colorado potato beetle, makes a sensible suggestion for the consideration of the people of the United States, which is worth bearing in mind on the part of our acclimatization societies. He thinks that if the rook were introduced into the United States it would have a very posi-

tive influence upon the existence and multiplication of insects that are injurious to vegetation, in view of the fact that its large size and semi-domestic habits especially qualify it for attacking such pests and destroying them on a large scale, feeding as it does almost exclusively upon insects and their larvæ; and as in consequence of its slight degree of shyness it will enter the gardens and orchards freely, and breed in colonies in the trees near country houses.

DR. COUES' MANUAL OF FIELD ORNITHOLOGY.

A "Manual of Field Ornithology," prepared by Dr. Elliott Coues, and published by the American Naturalist Agency of Salem, gives the result of Dr. Coues' experience as a collector in various regions of North America, from Labrador to California, and from Southern Arizona to the Lake of the Woods; and, as the production of an accomplished ornithologist and naturalist, and an extremely successful and skilled field explorer, can not fail to be of great service both to the beginner and the advanced student.

Not the least valuable feature of the volume consists in a new check list of North American birds, giving the result of the latest inquiries on the part of Dr. Coues and other ornithologists. The list published by the Smithsonian Institution, which has been in very extensive use for many years past, brings the subject down only to 1859, and in view of the additions and corrections of synonymy which have taken place since that time, there has been an urgent need of a new one, which has been satisfactorily met by Dr. Coues.

CATALOGUE OF AMERICAN BIRDS.

A catalogue of the birds of America south of the United States has lately been completed by Messrs. Sclater & Salvin, under the title of "Index Avium Neotropicalium," and embraces a total of 3565 species. The species peculiar to North America north of Mexico, and thus omitted by the authors, if added to the number given, would bring the whole up to 4000 species of birds belonging to the New World.

At the end of the list, the authors give descriptions of thirty-one species included therein previously undescribed, and the work itself is simply the forerunner of a much more extensive memoir, which is to embrace full descriptions of

genera and species, and to bear the title "Index Avium Americanorum."

AMERICAN KING-CRAB ON THE EUROPEAN COAST.

According to Mr. Edward Newman, in a communication to the *Field*, a fine specimen of the American king-crab, *Limulus polyphemus*, was taken in July last by the Yarmouth trawl-boats about eleven miles off the Schelling Light, on the Dutch coast, at least four or five having been taken in all during the summer. Mr. Newman remarks that as long ago as the 26th of April a report appeared that a specimen of this crab had been taken in North Wales, which was rejected by naturalists on account of the extreme improbability that this familiar American animal should be found on the European shores.—19 *A*, *November* 15, 1873, 511.

AN "ARMY WORM."

A correspondent of a daily paper recently called attention to a phenomenon which has greatly excited his curiosity, and which he refers to as something entirely unheard of. This, which he calls a combination snake, or "army worm," he describes as at first sight resembling a snake ten feet in length, tapering regularly from the middle toward the head and the tail, and moving along slowly. Supposing it to be a serpent, he was astonished to see the creature, on reaching a stone, divide sometimes into two or three heads, which subsequently were reunited into the original snake. On examining this peculiar body more closely, to his astonishment he found that it was composed of small worms, about three eighths of an inch in length, and about the thickness of a pin. One of these constituted the entire extremity of the figure; then two or three lapped on to it for two thirds of its length, and on them lapped others, increasing the thickness of the "snake" until it became about the size of a man's thumb in the middle, and tapering off toward the other end in a similar manner.

This object, although rare, is by no means unknown to naturalists. Its occurrence is more frequently recorded in Europe than in the United States. It consists, in reality, of the larvæ of an insect of the order of flies, probably belonging to the genus *Sciara* of the *Mycetophilidæ*. Professor

Cope has a paper on the subject in the proceedings of the Philadelphia Academy of Natural Sciences for 1868, and it is frequently referred to in European works, especially one by Max Nowicky, "Der Kopaliner Heerwurm" (Brünn, 1868), originally published in Vol. VI. of *Verhandlungen naturforschender Verein*, at Brünn. This phenomenon belongs to the series of mimetic resemblances so common in the animal kingdom, and has doubtless an important function in preventing attacks upon the defenseless larvæ in their movements from place to place; birds or other enemies being deterred by the apparent presence of a large and dangerous serpent.

DROWNING OF A CHINAMAN BY A HALIOTIS.

A recent California journal states that a Chinaman, while attempting to secure a large abalone (a well-known saucer-shaped shell of the genus *Haliotis*), was held fast, by its contraction, to the rock to which it was attached, until he perished by being ingulfed by the incoming tide.

DALL'S CATALOGUE OF THE SHELLS OF BEHRING'S STRAIT.

For the purpose of bringing together the sum of our knowledge on the subject, Mr. William H. Dall has lately published a catalogue of the shells of Behring's Strait and the Arctic Ocean, partly collected by himself and partly by others. He indicates one hundred and twenty-one species, of which three obtained by Captain Smith, and one by himself, he considers to be new to science.

DISCOVERY OF ALEUT MUMMIES.

Mr. W. H. Dall, in a communication to the California Academy of Sciences, remarks as follows: "I have previously given the Academy some account of the method practiced by the Aleutian Islanders of mummifying their more distinguished dead. Many tales are current among the Aleuts in regard to particular cases of this practice, and among others one has been frequently related to me in regard to some mummies preserved in a cave on one of the volcanic islands known as the 'Four Craters,' or 'Four Mountains.' When in the vicinity in 1873 we were unable to land and test the truth of this history on account of bad weather and the absence of any harbors. More recently, however, this has been

successfully done. The Alaska Commercial Company has a standing order to its agents to collect and preserve objects of interest in ethnology and natural history, and the cabinet of the Academy bears witness to the generosity of the company and the value of some of the material thus acquired. Captain E. Hennig, of the company's service, with the company's schooner *William Sutton*, being employed in removing some hunters from the island of the Four Mountains, was enabled, after seven unsuccessful attempts, to land at the base of the cliff where the fallen rocks form a kind of cave, and was directed by the natives to the exact spot. Here he obtained twelve mummies in good condition, besides several skulls of those which, being laid near the entrance of the cave, had become injured by the weather. There were also a moderate number of carvings and implements found, though some natives, less superstitious than the rest, had appropriated a quantity of weapons (reported to have once been there) for use in hunting. The island being volcanic, and, in fact, still active, the soil is still warm, and the atmosphere of the cave quite hot, which accounts for the extremely good preservation of the remains. Most of the bodies were simply eviscerated, stuffed with grass, dried, wrapped in furs and grass-matting, and then secured in a water-proof covering of seal-hide. Two or three had had much more pains bestowed upon them, and were of course of much more interest. The story of their deposition is too long to be given here, and is not particularly interesting, but it includes the fate of an old chief of the island of the Four Mountains and his family, all of whom were buried in the cave. Among the others was a female, who died when with child from a premature birth, brought on by an accident, and the essential correctness of the tradition is attested by the presence of a little mummy of the still-born infant. The date of the first interment is very well fixed by the fact that the old chief died the autumn before the spring in which the Russians made their first appearance at the Four Mountains; and consequently none of the bodies are much over one hundred years old. Hence they should not be confounded with the ancient pre-historic remains which I have formerly described in the Academy's proceedings.

"The mummies of real interest were few in number. The

most conspicuous was that of the old chief. I am informed that this body was enveloped in furs, dressed in the usual native attire, and furnished with a sort of wooden armor, formerly worn by the Aleuts. The whole was placed in a sort of basket, in a sitting posture, and carefully covered with water-proof skins, secured by line made of sinew, either braided or made into what sailors call 'square sennit.' This line, together with a net made of sinew, in which another of the bodies was secured, was very finely made, and nearly as perfect and strong as when first placed there. The matting, made of prepared grass, was exceedingly fine, in most cases far superior in finish and delicacy to any now made in the islands. One of the smaller mummies, in a triangular-shaped bundle or basket, had a pattern of a Maltese cross worked into a stripe of another color; this was quite fresh, and the grass still retained its red and yellow tinge. The largest basket had a wooden arrangement fastened with bone buttons, forming a broad hoop, which served it for a base. Most of the more carefully preserved specimens had been once suspended in the air by handles or cords attached to their envelopes.

"The other articles found in the cave were stone knives, and other implements, and a few carvings, one of which was supposed by the finder to be an idol, but this is probably an error. A child's boot of native make was found in the cave, with the fur perfectly preserved, and in it was a little ivory image of a sea-otter. A number of other bone and ivory toys or trinkets were also found."

NEW TERMS IN CRANIOLOGICAL DESCRIPTION.

The terms "dolichocephalic" and "brachycephalic," as applied to the shape of the human skull, have long been in use, and are well understood; but some additional appellations have lately been introduced which tend to give great precision to the idea of the cranial form. Among these we have the acrocephalic form, which has been applied to such skulls as are extended in a vertical direction, and are more or less cylindrical in form, instead of being acutely terminated. For the latter character the word oxycephalic has been applied by Dr. Zuckerkandel. The designation of

scaphocephalic is applied to the so-called boat-shaped cranium, of which a new modification has lately been described from Holland. In this the cranium is elongated or laterally compressed, and extended into a keel or ridge in the sagittal direction.—15 *A*, *October* 17, 1874, 515.

EFFECT OF PARASITISM IN THE ANIMAL SERIES.

Among the communications in the zoological section of the French Association, recently held at Lille, was one by Professor Vogt, on the effect of parasitism in the animal series, in which he endeavored to show that the most varied forms, belonging to very different groups, could in their degradation by parasitism lose in succession their different organs, so as to resemble each other very closely, and to render it very difficult to determine, without critical study and investigation, to what group a particular object belongs.

In this connection he mentions the *Entoconcha digitata*, the sacculines, and the trematodes, the starting-points of which, namely, the embryo, are very different, as belonging to entirely distinct groups. They, however, by successive retrograde metamorphoses, come to resemble each other to such a degree that, without the assistance of embryology, they could be classed in the same group, although the one belonged to the gasteropod-mollusca, the others to the cirrhipedes and the trematodes respectively.

Professor Giard, in remarking upon this paper, stated that he had already arrived at a similar conclusion in studying ascidians.—8 *B*, *September* 5, 1874, 237.

CHANGE OF VOLUME OF FISH IN SWIMMING.

According to a statement of results already established by an investigation by Harting, conducted by means of peculiar and very delicate apparatus, the chief causes of the change of volume of the bladder in fish, and consequently of the volume of the fish, are: 1, Variation of pressure upon the fish, resulting from an upward or downward movement made by the fins, the bladder being entirely passive in the case; 2, the separation and absorption of the gases contained in the bladder, as well as their removal through the air-duct; 3, the movement in breathing, not perceptible with all fishes;

4, the compression of the bladder by muscular action upon it—this was, however, seldom observed, and was very slight. Upon the whole, the bladder seems to play almost no active part in the upward and downward movements of fish in water. The experiments were, however confined to fresh-water fish.—19 *C*, *July* 11, 1874, 271.

THE DEVELOPMENT OF SHARKS AND RAYS.

Mr. F. M. Balfour, who was engaged in the summer of 1874 at the zoological station at Naples in investigating the development of the sharks and rays, announces to the British Association, as among the results attained, that, although as large a quantity of food-yolk is present in the egg of the shark as in that of a bird, there is found in the former a fine network of lines throughout; and around the germinal disk especially there are a number of nuclei. From the presence of these lines, and the nuclei, he concludes that the whole of the yolk, including both the germinal disk and the food-yolk, may be looked upon as a single body — the ovum — in the greater part of which passive food-yolk granules are embodied.

In regard to the mode in which this alimentary canal is formed, the shark is intermediate in condition between the frog and the bird, traces of the primitive mode of formation of the alimentary canal by an involution being retained in the shark, although lost in the bird.

Mr. Ray Lankester pointed out the very great importance of the discovery that the spinal rod, or notochord, develops in the sharks from one of the two primary layers of the germ, and not from a middle layer, as in the chick or frog. He thought the middle layer would have to be abandoned as an entity, and its elements traced to the outer and inner layers.—15 *A*, *August* 29, 1874, 279.

DEVELOPMENT OF THE EYE IN THE CUTTLE-FISH.

Mr. E. Ray Lankester has published an account of his observations upon the development of the eye in the cuttle-fish, in which he shows the radical difference in this respect from that of the vertebrates. In *Loligo* and *Sepia* the eye originates as a raised elliptical wall on the surface of the embryo. The wall closes in above, and thus the primary

optic vesicle is formed. From the front of this arise new wall-like growths, forming an anterior or second optic vesicle, cornea, and iris. The lens, curiously enough, is secreted from the cells of the anterior wall of the primary optic vesicle, and is quite free from cell-structure. It is a cuticular formation, such as the bristle of an annelid. The cells of the posterior part of the primary optic vesicle become modified, so as to form the two layers of retinal elements. It is important to observe that in *Nautilus* there is, as Heusen described, no lens, and but one optic chamber. In fact, *Nautilus* has exactly the arrangement in adult life which is seen in the early condition of the eye of the cuttle-fish, before the wall of the primitive optic vesicle has quite closed in. The small hole thus left permanently in *Nautilus* represents the pin-hole aperture in a camera obscura, and gives a luminous image.—15 *A*, *September* 5, 1874, 319.

RESPIRATION IN THE AMPHIBIA.

Modes of respiration of animals which are aquatic for a part of their existence are much varied. As is well known, the gills of larval salamanders are exposed, while those of frogs, etc., are concealed within a sac-like covering of the skin. The larvæ of a South American tree-frog (*Notodelphys ovifera*, Weinl.) possesses bell-shaped membranes in place of gills, over which the bronchial arteries and veins ramify. They occupy a sac on the back of the parent, which is formed by the involution of the ordinary integument. The *Cœciliæ* are snake-shaped batrachians, which are found in all tropical regions. They have no limbs, and frequently no tail. One species has been known to possess fissures on the side of the neck in the larval state, which subserve respiration before the animal assumes terrestrial life. It is the *Epicrium glutinosum* of Ceylon. Recently Professor Peters, of Berlin, announced the interesting fact that the large *Cœcilia compressicauda* of Surinam is viviparous—that the young are born in the water, and that they do not possess fissures, but external gills. These organs are flat, leaf-shaped sacs, which rest against the sides, and are supplied with the bronchial vessels. When the animal leaves the water, these appendages drop off, leaving a scar.

DECOMPOSITION OF EGGS.

According to Mr. William Thompson, of Manchester, the decomposition of eggs may be brought about by any one of three different agencies. The first, which he terms "putrid cell," is generated from the yolk, this swelling and absorbing or mixing entirely with the white, and ending with a true putrefaction. The second is that of the vibrio, the germs of which (floating as they do through the atmosphere), when settling on the moist surface of an egg, readily penetrate it, and set in motion the putrefactive condition; but when the shell is dry such penetration is impossible. The third is a fungus decomposition, in which the spores penetrate within the shell as before, sending filaments through the egg, and converting the white into the consistency of a strong jelly, the filaments being sometimes so abundant as to cause the whole contents to resemble a hard-boiled egg.—18 *A*, *August* 28, 1874, 612.

THE BASKING SHARK.

Professor Macalister gave an account, before the British Association, of a large basking shark (*Selache maximus*) lately examined by him, and he referred to the recently established fact of its entire absence of ferocity, and to its feeding on small crustaceans, which are caught by taking them into the mouth and forcing the water through whalebone-like strainers, between the gill arches, composed of true dentine, and which prevent the food from escaping between the gill slits. —15 *A*, *August* 29, 1874, 281.

A NEW SPECIES OF CASSOWARY.

According to a recent paper by Dr. Sclater, a hitherto undescribed species of cassowary is to be added to the seven or eight now known as occurring in New Guinea and the adjacent islands. This new species was taken at the southern extremity of New Guinea, and has recently reached London. It is closely allied to Bennett's cassowary and Westerman's cassowary, and belongs to the same section of the genus, having the transverse ridge across the helmet, and the want of caruncles in the neck. It is described as *Casuarius picticollis*. The indications furnished by the discovery of this

additional species in New Guinea point to the fact that this little-known island is Australian, rather than Malayan, in its biological character.—15 *A*, *August* 29, 1874, 281.

TAMING THE ZEBRA.

For many years the zebra has been considered as absolutely untamable, but one or two instances of the contrary being recorded, and considered as remarkable exceptions to the general rule. The Acclimatization Society of Paris, shortly before the Franco-German war, commenced experiments with a view to determine whether their taming was actually possible or not, but without much progress, as the exigencies of the siege made it necessary to convert them, with other animals in the society's gardens, into articles of food.

In 1872 a number of extremely vicious zebras were secured, and the experiment renewed. At first they were entirely unmanageable, but became more docile after horses were kept with them for some time. Since then they have been readily harnessed, and are found to work steadily and well. The bulletin of the society now announces that there is no question as to the possibility of domesticating the zebra, if treated kindiy, and that they can be usefully employed for draught animals, having great endurance and vigor, and occupying a position between the horse and the ass, but in all essential respects corresponding with the latter animal.

CLOSE TIME FOR BIRDS IN GREAT BRITAIN.

The committee appointed by the British Association to bring before the public the question of a close time for the preservation of indigenous animals, reported at a late meeting the steps they had taken toward this object, and expressed the belief that the effect of birds'-nesting on such kinds of birds as are known to be diminishing is altogether inappreciable, while its effect on those whose numbers are not decreasing may be safely disregarded, and consequently that there is no need of any legislative interference with the practice. The committee believed that the only practicable mode of checking the diminution of such birds as have been proved to be decreasing is the effectual protection of the adults from destruction during the breeding season.—12 *A*, *September* 10, 1874, 388.

LIEUTENANT WHEELER'S EXPEDITION.

Of the various government exploring expeditions that have been in the field during the past summer, the most signal success has been experienced by the party of Lieutenant Wheeler, in the discovery of certain new beds of fossil vertebrates, from which a large number of new species have been derived. The division by which this result has been achieved was under the command of Dr. H. C. Yarrow, in charge of the natural-history department of the survey, accompanied by Professor E. D. Cope, with several assistants. One of the newly discovered beds belongs to the eocene tertiary period, and originally constituted a fresh-water lake, probably drained off by the Chama and San Juan Rivers. The shores of the lake are formed of cretaceous rocks of an age corresponding to that of the No. 3 of Meek and Hayden. The rock in which the fossils occur is a brown and white sandstone of about a thousand feet in thickness.

A preliminary investigation given to the collections by Professor Cope shows marked differences from those of the Bridge Basin of Wyoming, some of the more characteristic genera being *Bathmodon*, *Hipposyus*, and *Phenacodus*. It is a remarkable fact in this connection that there are several species of sharks and an *Ostrea* found in connection with the mammals.

What Professor Cope considers the most striking feature of the discovery is the occurrence of two new genera, which he calls *Calamodon* and *Eitoganus*, belonging to the *Toxodontia*, an order of mammals not heretofore found in North America. Of the last-mentioned genus three species were found, and of the former one, all of them of about the size of the tapir. One reptile, a species of alligator resembling the *A. neterodon* of the Wyoming bed, was also detected.

KOWALEVSKY ON THE BRACHIOPODS.

Professor Kowalevsky, the great Russian naturalist, has recently published at Moscow the results of his investigations on the embryology of certain Brachiopoda studied in the Mediterranean. He fully confirms the researches made by Edward S. Morse on the Brachiopoda of this coast, and indorses the views Mr. Morse entertains regarding their rela-

tions with the worms. The following is translated from his work: "The first part of my article was already printed when, through the kindness of a friend, I obtained for a few days the new work of Mr. Morse on the 'Systematic Position of the Brachiopoda,' sent from Berlin, from Mr. Martens. It was while fresh from the impression produced on me by the views of the American scientist that I wrote the last portion of my general review, although I had myself previously arrived at the conclusion, based upon the homologies of the mussels and setæ, that the brachiopods are nearly allied to the chætopod annelides."

FOSSIL BIRDS FROM THE SHEPPEY CLAY.

Professor Seeley has lately obtained from the London clay the tibia of a large bird, which he considers closely allied to the emu, showing also relations to the apteryx. It was found in the Isle of Sheppey, in which so many valuable fossil vertebrates have been obtained.—5 *A*, *October*, 1874, 437.

THECOMEDUSÆ, A NEW ORDER OF HYDROZOA.

Professor Allman has lately described, under the name of *Thecomedusæ*, what he considers a new order of Hydrozoa, based upon his *Stephanocyphus mirabilis*, which is not a hydroid, and can not be referred to any of the existing orders of the Hydrozoa. The chitonous tubes which permeate the sponge-tissue are united toward the base of the sponge, and constitute a composite colony of zöoids. The tubes are increased in width toward their free extremity, and the polypite inhabiting each puts forth a retractile crown of tentacles. In many respects it resembles the Campanularian zoophytes. In no instance was it unaccompanied by the sponge.—5 *A*, *October*, 1874, 446.

H. BOTANY.

BOTANY OF THE BERMUDAS.

According to Mr. Moseley, botanist of the *Challenger*, about one hundred and sixty species of flowering plants were gathered by him on the island of the Bermudas, of which only one hundred are certainly native, those from the West Indies having probably been brought by the Gulf Stream or by cyclones. Seventy-one of the species belong to the Old World, while two are plants hitherto known only as confined to single localities in the United States.—15 *A*, *January* 10, 1874, 42.

VARIATION OF THE RATE OF GROWTH OF PLANTS WITH THE TIME OF DAY.

According to experiments by Trauth upon squash, tobacco, and other plants, the rate of growth varies during the day; the increase being greater from the evening during the night, and attaining its maximum toward daybreak, and then declining. Culture, under glass shades, showed that the difference in growth was not due to the increased transpiration during the day, but that the temperature has a considerable influence. The difference in growth of the leaves, in light and in darkness, could not be traced to the number of the cells. —21 *A*, *April*, 1874, 381.

ELECTRICAL PHENOMENA IN PLANTS.

Dr. Sanderson describes some highly curious electrical phenomena which accompany the irritation of the plants *Dionæa muscipula*. He states that when the opposite ends of a living leaf of *Dionæa* are placed on polarizing electrodes, in mutual connection with each other, and a reflecting galvanometer of high resistance is introduced into the circuit thus formed, a deflection is observed, which indicates the existence of a current from the proximal to the distal end of the leaf. This current he calls the normal leaf current. If, instead of the leaf, the leaf-stalk is placed on the electrodes, while the leaf remains united to it, in such a way that the extreme end of the stalk rests on one electrode and a part of

the stalk at some distance from the leaf on the other, a current is then indicated which is opposed to that in the leaf current: this he calls the stalk current. After describing numerous variations in this experiment, all tending to show that feeble electric currents are passing through both leaf and stalk, he states that, if the leaf is so placed on the electrodes that a normal leaf current is indicated, and a fly be then allowed to creep into the leaf, it is observed that the moment the fly reaches the interior so as to touch the sensitive hairs on the upper surface, the galvanometer needle springs to the right if it had previously been deflected to the left, and the leaf at the same moment closes on the fly. The fly, having been caught, does not remain quiet; and each time it moves the needle again springs to the right. The same series of phenomena present themselves if the leaf is touched with a camel's-hair pencil.—*Proc. Roy. Soc., London*, XXI., 495.

SEA-WEEDS OF THE BAY OF FUNDY.

Professor Eaton has published a list of the marine algæ collected near Eastport, Maine, in the summer of 1872, in connection with the investigations of the United States Fish Commission. The specimens were gathered partly by himself, and partly by Messrs. Verrill, Prudden, Isham, and Palmer. The list numbers fifty-six species, of which several are recorded for the first time on the American coast. As the collections were made only in the months of August and September, Professor Eaton thinks that many species yet remain to reward the diligence of the gatherer.

DIFFUSION OF POLLEN IN THE ATMOSPHERE.

A very suggestive series of experiments has been made by Mr. Blackly in connection with his researches upon the "hay fever," with a view to determine the extent to which pollen of various plants is diffused throughout the atmosphere. His first series of inquiries was instituted in a meadow at the average breathing level of four feet nine inches from the ground, beginning in April and continuing until the end of July. A slip of glass was exposed horizontally, coated with a thin layer of non-drying liquid. The results were tabulated daily; and the highest number of pollen grains obtained on a square centimeter in 24 hours was 880, June 28th. Sudden

diminutions in the quantity of pollen—when these occurred in the ascending scale, between May 28 and June 28—were invariably due to a fall of rain, or to this and a fall in temperature. Mr. Blackly also examined the amount of pollen to be found in the higher strata of the atmosphere. This was done by means of a kite, which, by being attached to other kites, sometimes attained an elevation of 1000 feet. The pollen was found to be much more largely present at the upper levels than at the "breathing level." Taking the average of the quantities where pollen was present at both levels, he found that, while the average of the ordinary level was only 24 for each experiment, that for the higher levels was 472.33, or more than 19 times as much. After making due allowance for the difference in the velocity of the air at various altitudes, there still remains a great preponderance unaccounted for in the amount of pollen in the upper strata.

Mr. Blackly remarks that his experiments also afforded abundant proof of the presence of fungoid spores in the air in large quantities. In one experiment, which lasted four hours, and in which the number of pollen grains collected at an altitude of 1000 feet was 1200, the spores of a cryptogam (probably *Ustilago segetum*) were so numerous that he could not count them. At a rough estimate, they could not be less than thirty to forty thousand to the square inch. A fact like this makes the ubiquity of fungoid organisms a thing easy to comprehend.

That these organized contents of air travel to a considerable distance was proved by a series of experiments made in the outskirts of Manchester, but within the boundary of one of the most densely populated parts, and in no direction within less than one third of a mile of grass land. The quantity of pollen was only about one tenth of that collected in the country.—13 *A*, *October* 1, 1873, 375.

FUNGUS INSIDE OF FRESH EGGS.

Professor Panceri has ascertained the existence, in an unbroken egg-shell, of a large amount of cryptogamic vegetation, and he has satisfied himself that the unbroken shell of any egg is permeable to liquids, and that these may introduce germs into the interior. He has, in fact, succeeded in inoculating other eggs with a fungus which he had obtained from

the interior of one where it occurred spontaneously. He cultivated the fungus in egg-albumen, and thus conveyed it to uncontaminated eggs.—13 *A*, *February* 21, 1874, 207.

CAUSE OF PHOSPHORESCENCE OF DECAYING WOOD.

It is stated that the attempt to account for the phosphorescence of decaying wood by the assumption of a peculiar process of combustion accompanying decay has lately been rendered unnecessary by the discovery of the presence on such wood of a fungus which emits light, as a result of vital processes, and which, without destruction of this power, can be scraped off and transferred to other wood; even animal matter may be rendered phosphorescent by it. High temperature, or gases that destroy life, as well as the withdrawal of the requisite degree of moisture, cause instant cessation of the light.

THE ASCENT OF SAP IN PLANTS.

Professor McNab has presented to the Royal Irish Academy a memoir on the ascent of water in the stems of plants, to investigate which point very many experiments were made. He finds, in the privet, the rate of ascent to be about six inches per hour; in the elm, 16.6 inches per hour; in the cherry laurel the rate varied from 24 to 13 inches. Experiments were also made as to the influence of sunlight and darkness, the influence of the bark, the influence of the leaves, and the influence of pressure.—12 *A*, IX., 355.

PROMOTION OF GERMINATION BY CAMPHOR-WATER.

A series of experiments, undertaken by Professor Vogel, of Munich, to substantiate the fact that camphor-water promotes the growth and prevents the wilting of tulips, etc., led to the discovery that old seeds, which have almost lost the power of germination, not only recover it when treated with camphor-water, but even germinate in larger numbers and more rapidly than fresh seeds under ordinary conditions. Thus beans, that required eight to ten days for germination under ordinary conditions, developed in camphor-water after three days; and cucumber seed that would not germinate at all in good soil, germinated soon, and without a single failure, in camphor-water; and, what is more remarkable still,

the seeds so germinated manifest a continued effect of the camphor, when transferred to good garden soil, in the vigor of growth and freshness of the plants. This fact, it is suggested, might be of service, especially in cases of expensive seeds that germinate with difficulty.—1 *C*, V., 79.

GERMINATION AND GROWTH AT LOW TEMPERATURES.

The interesting observation of Uloth that grains of wheat accidentally inclosed in ice will germinate, and send their rootlets into it, has been found corroborated on a large scale in the Alps by Kerner. His investigations of the vegetation on the margin of the snow-fields clearly prove, not only that germination can take place at 32°, but that stalks and flowers may also be developed at that temperature. Water formed by the melting of the snow, sinking into the earth, serves to excite organic changes in small plants buried beneath the snow and ice, and the heat liberated by the respiration of the plant melts the ice in contact with it, and the growing portions force themselves into the cavities thus formed. The small stems thus frequently force their way up through one or two inches of ice, and finally perforate it, and appear, with their blossoms, above it. Alpine flowers were even found in full bloom incased in ice, just as insects are in amber, although, as a rule, the complete development of the flower only takes places above the ice. Not unfrequently the margins of the snow-fields, converted into ice and granular snow, are diversified by hundreds of Alpine flowers—among them, at times, the soldanella.—19 *C*, *October* 25, 1873, 403.

MANGANESE IN SEEDS.

Some years ago the French missionaries, in returning from China, brought with them a certain vegetable substance which they called gutta-percha seeds, and known in its native country as *Tambayous.* They belong to the genus *Sterculia*, of the family of *Sapotaceæ.* Quite recently a chemical analysis has been made of these seeds, and the interesting fact developed that the ash contains 17 per cent. of oxide of manganese, 14 per cent. of magnesia, and 12 of lime. The large percentage of manganese is a very striking fact, said to be unparalleled in the vegetable kingdom. Its occurrence in small quantity in the leaves of the beech-tree has but recent-

ly been known. The tambayous are considered in various parts of India as very efficacious in intestinal affections, especially in cases of diarrhœa resulting from sudden changes in the temperature of the atmosphere.—3 *B*, *April* 2, 1874, 616.

EFFECT OF TEMPERATURE UPON THE GERMINATING POWER OF WHEAT.

Very careful and numerous experiments establish the fact that wheat can endure a much higher temperature than has been generally supposed without losing the power of germination, 149° having been considered the limit. It may indeed be exposed to the boiling temperature, if the drying of the seed is effected by very gradual elevation of the temperature, and with the aid of chloride of calcium.—8 *C*, *April* 30, 1874, 157.

THE SNOW-FLOWER.

A very remarkable account is admitted into *Les Mondes* of a so-called *snow-flower*, said to have been discovered by Count Anthoskoff in 1863 in the northernmost portion of Siberia, where the earth is continually covered with a coating of frost. This wonderful object shoots forth from the frozen soil the first day of the year, and reaches a height of over three feet, blooms on the third day, remains open twenty-four hours, and then returns to its original elements. It shines for a single day, then the stem, leaves, and flower are converted into snow. The leaves are three in number, and about three inches in diameter, covered with a kind of microscopic ice, developed only on that side of the stem which is turned to the north. The flower, when open, is star-shaped, its petals of the same length with the leaves, and about half an inch wide. On the third day the extremities of the anthers, which are five in number, show minute glistening specks, like diamonds, about the size of a pin's head, which are the seeds of this astonishing flower.

Count Anthoskoff collected some of these seeds, and hastened with them to St. Petersburg. They were there placed in a pot of snow, where they remained for an entire year, but on the 1st of January, 1864, the snow-flower burst through its icy envelope, and displayed its beauties before the eyes of the imperial court!—3 *B*, *October* 16, 1873, 262.

NEW YEARLY REPORT OF THE PROGRESS OF BOTANY.

Dr. Leopold Just, of Carlsruhe, in Baden, announces his intention to publish, under the title of *Botanischer Jahresbericht*, a yearly report of the progress of botany in all its departments, and has issued a circular asking the co-operation of all persons interested. He has secured the assistance of numerous German botanical specialists in elaborating particular portions of his proposed work, and promises that within a few months after the expiration of each year his annual shall make its appearance. He asks all authors to send him as soon as possible every thing that they have published since the 1st of January, 1873, and to continue this regularly hereafter. He wishes especially extra copies of botanical papers in transactions of societies or periodicals, in order the more readily to distribute them to his collaborators. He expresses his willingness, also, to return to the authors any copies of their works lent him for examination, although, should nothing to the contrary be expressed, he begs permission to retain them.—*Circular, Dr. Just.*

THE EUCALYPTUS GLOBULUS.

According to a communication by Mr. Sowerby to the Royal Botanical Society, the *Eucalyptus globulus*, the plant so much talked about recently, grows finely in the society's gardens, one of them, seven years old, being fifteen feet high. Experiments were under way for trying its growth in the open air; but it was thought that, except in the extreme south or west of England, it would not stand an ordinary English winter.

Professor Bentley stated that, although probably some of the properties of the *Eucalyptus* were exaggerated, its efficiency in fevers has been well established, and that it is used with success in Australia and elsewhere as a remedy in such cases. It is found, however, not to possess any of the cinchona alkaloids, as had been previously claimed. The virtues of the tree in draining marshy lands and in improving the sanitary condition of a country were also dwelt upon. It was remarked that this plant yields the Eucalyptus oil, now imported into England, as also an astringent substance, which is applicable, like catechu, in medicine and in the arts.

CHINESE OIL-BEANS.

These beans, remarkable for the amount of proteine matter and oil they contain, are but little used as food for man, but are cultivated mainly as feed for cattle and for fertilizing. The ripe beans, as well as the oil-cake, are fed; the oil-cake also serving as a manure for sugar-cane and mulberry-trees. The oil, expressed as usual by wedges, has a honey-yellow tint, and a rather delicate and pleasant odor, and is quite fluid. It may be used as a table oil, or for illumination, without previous purification. A clay soil seems best adapted to the cultivation of the oil-beans, which in China is well fertilized with bone and wood ashes, with the addition of the sediment of the numerous canals. The stalks need no support. The harvest occurs in October, when the beans are trampled out and the straw utilized as fuel.—1 *C*, 1873, 266.

ORIGIN OF THE DOMESTIC VINE.

According to Dr. Riegel, director of the Botanical Gardens of St. Petersburg, the cultivated vine of Europe is not a distinct species, but a hybrid between the *V. labrusca* and *V. vulpina* of Linnæus. The former of these two species is met with in a wild state in North America, Japan, Mantchooria, and the Himalayas, and is characterized by having a cotton-like down on the inferior face of the leaves. The second species is also found wild in the same countries, but has only short hairs on the inferior face of the leaves, which are also short and stiff upon the nerves. From the first of these has been derived two of the most remarkable of the American cultivated vines—namely, the Catawba and the Isabella.—12 *A*, *January* 8, 1874, 192.

RECENT USES OF SEA-WEED.

By subjecting sea-weed to distillation with superheated steam, according to Stanford's process, instead of simply reducing it to ashes, as has hitherto been done, not only can illuminating gas, acetic acid, and combustible oils be obtained, but iodine, chloride of potassium, etc., can be extracted from the residue. The charcoal residuum also possesses an unusual decolorizing power, and can be employed for disinfecting water-closets, in such manner as to constitute a

source of ammonia, by further distillation.—6 *C*, *September* 11, 1873, 368.

NEW SPECIES OF PLANT FORMING A CARBONATE OF LIME INCRUSTATION.

Wibel and Zacharias have observed in the River Bille, near Hamburg, large quantities of a species of *Potamogeton*, which, like many confervæ, algæ, etc., accumulates an incrustation of beautiful crystalline carbonate of lime. The process is due, it is suggested, to the removal of one equivalent of carbonic acid from the bicarbonate in solution.—28 *C*, *May*, 1874, 393.

ORNAMENTAL BEGONIAS.

Dr. Sacc, in *Les Mondes*, calls attention to a new form of ornamental begonias, suited for window plants, which differ from those first introduced in the fact that, while the leaves are small and highly ornamental, the flowers are large and brilliant. In one of these, which he calls *Begonia sidérié*, the stems are red and the leaves dark green, thick, and smooth, while the flowers are of a most beautiful red. One of these begonias, received by him in May last, had four leaves, and was barely an inch high. In June it put forth its first flowers, with which it was constantly covered for many months, forming ultimately an enormous tuft sixteen inches in diameter and as many in height. No plant known to Dr. Sacc flowers so freely, and is so easily cultivated; and he is convinced that, in a few years, as ornamental window plants, the flowering begonias will dethrone all others.—3 *B*, *November* 27 1873, 570.

RECENT PUBLICATIONS IN SYSTEMATIC BOTANY.

Among the recent publications in systematic botany should be mentioned the long-delayed report by Dr. Torrey upon the collection made in California and the Columbia Valley by the Wilkes exploring expedition. This was prepared long ago, and a set of superior steel engravings designed to accompany it were printed and partially distributed. The text is now added, under the care of Dr. Gray, but with few changes in the original matter. Though much that was new is no longer so, the report will be of value as giving the latest

views of Dr. Torrey upon many botanical points of interest. Dr. Gray has also given, in the proceedings of the American Academy, the conclusion of his former communication upon *Compositæ*, chiefly Californian. It contains revisions of *Hemizonia*, *Helenium*, *Microseris*, *Malacothrix*, and several other genera. In the same proceedings appears a monograph, by Sereno Watson, of the North American *Chenopodiaceæ*, an order largely represented in the region west of the Rocky Mountains. In an earlier article Dr. William G. Farlow, of Cambridge, details the circumstances of the growth of a fern directly from the spore, without the ordinary preliminary development of sexual organs and fertilization by spermatozoids. This is a unique example of what may apparently be considered partheno-genesis in plants, a few only partially proved cases of which have before been noticed in some phænogamous species.

PERIODICAL FLOW OF SAP IN TREES.

Baranetzky, of the observatory at Kief, has investigated the periodicity of the bleeding of certain plants and its cause. Hoffmeister was the first who recognized that this phenomenon was one very widely observed among forest trees, and the daily and annual periods of this flow of sap have been examined into by several persons. Among the newer results arrived at by Baranetzky, it may be mentioned that he has been able to show that the daily variations of temperature had but little to do with the flow of sap; the latter being as decided in trees protected from temperature variations, by being inclosed in the hot-houses of the botanical gardens, as in the trees of the open air. The variations are perfectly regular, attaining their maxima and minima on the same day and at the same hours, and seem to him to indicate that the influence of temperature on the periodicity of the bleeding is, at least by certain plants, not direct and immediate, but of such a nature that it at first becomes manifest some time after the action of that which causes it. By introducing an artificial temperature variation, this idea was brought to a severe test, and it was shown that the temperature had really but little to do with the flow of sap, although it would be hasty to conclude that it had no influence whatever. It is only in the case of great temperature variations (for instance, a change

of 20° Fahr.) that the normal rate of flow of sap is sensibly disturbed.—*Abh. Naturf. Gesellsch., Halle*, XIII., 30.

SARRACENIA VARIOLARIS AS AN ANIMAL-EATER.

Recent observations have been made by Dr. J. F. Mellichamp, of Bluffton, S. C., upon the *Sarracenia variolaris*, which abounds in that region, with some new and curious results. This species of the pitcher plant has an elongated conical, erect leaf, with a broad lamina curved over the opening, and a wide longitudinal wing upon one side the whole length of the tube. The upper portion is veined with purple, the intervening spaces being white and diaphanous. Dr. Mellichamp establishes the following points: The base of the tube secretes a watery fluid, which is not sweet nor odorous, but which proves quickly fatal to all insects that fall into it. The whole inner surface is covered with very minute, closely appressed prickles, perfectly smooth, and pointed downward, which render it impossible for an insect to ascend by walking, even when the leaf is laid nearly horizontal. Within the somewhat dilated rim of the tube there is a band half an inch in width, dotted with a sweet secretion, attractive to insects, but not intoxicating. This also extends downward along the edge of the outer wing to the very ground, thus alluring many creeping insects, and especially ants, to the more dangerous feeding-ground above, where once losing foothold it is impossible to regain it. Even flies escape but rarely, the form of the tube and lid seeming effectually to obstruct their flight. As the result, the tube becomes filled to the depth of some inches with a mass of decaying ants, flies, hornets, and other insects. Within this there is always found a white grub feeding upon the material thus gathered, perhaps the larva of a large fly which has been observed to stand upon the edge of the tube and drop an egg within it. Soon after the full development of the leaf the upper portion becomes brown and shriveled, which is due to still another larva, the young of a small moth, which feeds upon the substance of the leaf, leaving only the outer epidermis, and works its way from above downward till in due time it spins its cocoon, suspending it by silken threads just above the surface of the insect *débris* at the bottom. The whole forms a series of relationships and an instance of contrivance and design,

the full purport of which is still by no means fully understood. Other species of the genus, as also the allied *Darlingtonia* of California, manifest the same purpose of insect-capture, whatever the final object may be.

PHYSIOLOGICAL CLASSIFICATION OF PLANTS.

A classification of plants, based upon physiological characters and their relations to climatic conditions, has been recently proposed by M. A. de Candolle, and discussed with special reference to its bearing upon the study of the vegetation of the globe in past ages. He divides plants into six groups, sufficiently well characterized within general limits, of which the first includes plants requiring a large amount of heat and moisture, such as are now found in the hot, damp valleys of the tropics, where the mean temperature exceeds 86° Fahr., and moisture is never wanting. These he designated as Megatherms—mainly woody plants and evergreen climbers, including forest trees of numerous species growing together, and air-plants in comparative abundance. Fossil remains show that at a very early period a flora of nearly identical character was distributed over a large part of the globe, but since the beginning of the tertiary era it has become limited more and more closely to the equatorial regions.

The second group (Xerophiles) requires as much heat but less moisture, occupying the dry regions from Southern California east and southward, certain portions of South America, and in the Old World from the Senegal to Arabia and the Indus, Australia, South Africa, etc. It includes few trees, but many shrubby or herbaceous perennials, and numerous succulent plants. The third group of Mesotherms requires a more moderate degree of heat (a mean of 58°–68° Fahr.) and of moisture, and comprises much of the flora of the Southern States, California, China and Japan, New Zealand and Tasmania, the Mediterranean region, and the like, including a great variety of orders. A similar flora existed during the early tertiary period in Spitzbergen and much of North America, the vegetation of the United States and Japan being then nearly identical. The fourth group (Microtherms) is limited by a mean temperature of 32°–58° Fahr., and is characterized by the abundance of deciduous trees, conifers (the forests often formed by trees of but a single species),

herbaceous perennials, and by the absence of members of the preceding groups. The next group (Hekistotherms) comprises arctic or alpine plants, requiring very little heat, and able to endure the long darkness of winter. The orders represented are not numerous, and woody species are comparatively rare. A sixth group, styled Megistotherms, may be formed of such plants as demand an extreme degree of heat, now scarcely represented upon the earth, but formerly including the algæ, ferns, and lycopods of the carboniferous period. The constitutional peculiarities of plants upon which this grouping is based are accounted for by no known modifications of either external or internal structure or composition. De Candolle attempts to explain them upon the principle of heredity, the present constitution being the result of long-continued habit. He considers it an established fact that in the earliest ages there prevailed over the entire globe a uniform climate of high temperature, followed by a very gradual cooling, and the establishment by slow degrees of distinct and localized climates. He assumes, as a necessary consequence, that the earliest flora must have been as general and as uniform, consisting wholly of Megistotherms, which, as the temperature declined, were gradually driven from the poles toward the equator, their place becoming occupied by the other groups, successively, or as circumstances favored. In what way the several groups were developed is a question kindred to that respecting the evolution of specific forms, and the hypothesis of Darwin is equally applicable in its solution. The correctness of that hypothesis De Candolle does not consider, but he expresses the opinion that it is the only hypothesis worthy of discussion that has yet been advanced.

GEOGRAPHICAL DISTRIBUTION OF THE CUPULIFERÆ.

This large family, including the chestnuts, oaks, and beeches, since it is the earliest geologically of the dicotyledonous plants, affords much promise of definite conclusions in regard to the genetic relations of the present species from a comparison of the living and fossil forms, and the first results of an extended investigation in this direction by A. S. Oersted, in which the morphology, classification, and geographical distribution of the family are treated, has been published in

the transactions of the Copenhagen Academy. The conclusions in regard to geographical distribution harmonize with the generally received law that the more the classification of a family rests on characteristics which indicate a real relationship, the clearer it appears that each subdivision has its own centre of distribution; and, further, that the greater the differences of organization between the subdivisions, the greater the geographical distances between these centres. Thus the chestnuts, oaks, and beeches, constituting the three groups of this family, afford three principal centres of distribution, and cover three large, widely separated geographical regions; the chestnuts having their centre in the Malay Islands, the oaks in Mexico, and the beeches in South America. The chestnut group, which is sharply separated from the other groups, also has its own peculiar, tolerably well-defined region, manifesting its greatest diversity of form and its purest types on the Malay Islands, especially on Java and Sumatra, where its proper centre lies. But one species passes its boundaries toward the west, and plays an important part around the Mediterranean, and three species are found in America; while the typical genus is found exclusively on the Malay Islands, where only a few species of chestnut-oak are found, and not a single true oak. In a similar manner the oak group occurs chiefly in America, north of the equator, forming a second centre of distribution in the mountains of Mexico, where it manifests not only more numerous species, but also greater diversity of organization, than any where else, several large subdivisions being found that are not met with elsewhere, while chestnuts and beeches are entirely wanting. Although the beech group exhibits such a preponderance of species in Chile that that country must be regarded as its proper home, still the species are so scattered that it is difficult, with the present distribution of land and water, to refer all to a single centre. This difficulty is not so great, however, in regard to *Nothofagus*, which occurs in New Zealand and Van Dieman's Land, since there are other grounds for assuming that these were at one period connected with Chile. Still it seems impossible to refer the species of *Fagus* to the same centre, since the nearest related species is separated by 70° of latitude from the beeches of the south; so that, paradoxical as it may appear, Japan seems once to

have formed the connection between the beeches of the north and south, just as we find points of contact between Chile and Japan in other respects. An explanation of this is afforded by the fact that the beeches of Japan conform to those of the miocene epoch. The centre of distribution of the typical beeches must therefore be sought in a past geological period, and from it they must have been dispersed in different directions before the present distribution of land and water. Besides the three principal centres alluded to, there are also three secondary centres of distribution characterized by peculiar genera and sub-genera. The principal groups, in passing beyond their respective regions and mingling with each other, have produced regions of transition, in which forms appear which are the connecting links between the types from the different centres. Various facts in regard to the distribution of plants in general are also peculiarly illustrated by this family. Thus it exhibits most clearly the marked difference between the floras of Mexico and the Antilles, the oaks being more numerous in Mexico than any other portion of the world, while they are wholly wanting in the Antilles, although the latter afford climatic conditions favorable to their growth in many places. This contrast can be partially explained, as regards the oaks, by the fact that the seeds of the latter soon lose their power of germination, and are not easily transported by currents; and, besides, the oaks occur in the mountainous regions of Mexico, remote from the sea; and even if the seeds were transported by the aid of rivers, they would not find conditions favorable to their development on the coast of the Antilles—a fact in harmony with the general rule that the larger number of the plants common to the Antilles and the continent belong to the lowlands of the tropics, while the plants of the mountains are generally endemic. The distribution of the cupuliferæ also substantiates in a remarkable manner the general rule that the floras richest in endemic species are those where the physical obstructions to diffusion of plants are greatest; the ocean, high snow-covered mountain ranges, especially those with their axes perpendicular to the direction of the wind, forming sharply defined limits of floras. Thus, while the white oak occurs all over Europe, the species of cupuliferæ in Sumatra and Java are entirely different from each other. In like manner the characteristic cupuliferæ of

California are restricted to the western slope of the Nevada chain, and the beeches of Chile are entirely excluded from the east side of the snow-covered Cordilleras. This family also manifests the usual anomalies to the general rule that the zone of vegetation becomes more elevated near the equator, caused by peculiarities in the form of the mountains and the influence of clouds—a high plateau, with stronger insolation, producing a considerable elevation of the zone and the snow-line, as in Bolivia and Thibet, while abrupt, isolated peaks have a reverse effect. Thus Europe exhibits the influence of plateaus upon the cupuliferæ in two points—namely, in the central part of the Alps, in the weaker development and the lowering of the zone of the beeches, while the pine and larch, to which a mountainous climate is very favorable, form a broad zone in Wallis and Granbünden, 500 to 1000 feet higher than in the Bavarian Alps. Again, the chestnut zone, which reaches 5000 feet on the Sierra Nevadas, which rest on the plateau of Granada, does not rise above 3200 feet in the same latitude in Portugal. This is owing, it is true, in part to peculiar climatic conditions, which produce an unusual depression of the zones in Portugal, and which also manifest themselves in rendering the zone of vegetation much lower in Sumatra than in Java, on account of the difference in insolation, caused by the more frequent and heavier clouds in Sumatra, where the axis of the mountains is perpendicular to the course of the moist, prevailing winds, while in Java it is parallel to it. In this respect Portugal resembles Sumatra, and nowhere are the effects of similar climatic conditions more evident than in the southern portions of Chile and in Terra del Fuego.—19 *C*, *December* 27, 1873, 489.

EFFECT OF CARBONIC ACID AND OF OXYGEN ON THE GROWTH OF PLANTS.

The effect of carbonic acid upon the germination of seeds and upon the development of chlorophyl in young plants has been made the subject of investigation by Boehm. Seeds of sunflower, garden-cress, flax, poppy, oat, barley, rye, knot-grass, and maize were allowed to germinate and grow in flasks containing mixtures of atmospheric air and carbonic acid, the amount of the latter varying from 2 to 50 per cent. in the different flasks. The latter was exposed to diffused

daylight, at a temperature of 15° to 22° Centigrade. The injurious effects of carbonic acid on germination, observed by Saussure, were here confirmed. As regards the effect upon the development of chlorophyl in the young plants, the author concludes as follows:

"The experiments described suffice, as I believe, to show the remarkably injurious effect of carbonic-acid gas on the verdure and growth of the plants. The presence of only two per cent. of carbonic acid in the air becomes noticeable, especially by its effect on the formation of chlorophyl. . . . In an atmosphere which, with an amount of oxygen equal to that in the air, contains one-half carbonic acid, not only was there no growth, but the plants after a short time perished."

This effect of carbonic acid upon the plantlet, while living at the expense of the reserve nutriment in the seed, the author regards as very remarkable, in view of the fact that green leaves in such a medium decompose the carbonic acid with considerable energy. He remarks:

"Since the green plants are, in virtue of their capacity for decomposing carbonic acid, in condition to build up their substance from inorganic material, they create for themselves at the same time the condition of growth at the expense of material already assimilated."

These observations have, in the opinion of the author, an important bearing upon the theory that, before and during the period of carboniferous deposits on the surface of the earth, the atmosphere contained very much more carbonic acid than at present. He says:

"In view of the fact that plants visibly sicken in an atmosphere which contains but a small percentage of carbonic acid, we must conclude that, in an atmosphere not much richer in carbonic acid than that now existing, a part, at least, of the present vegetation of the earth would perish. But from this, one of two things must follow. Either the composition of the terrestrial atmosphere must always have remained the same, as must necessarily be inferred from its boundlessness; or, as seems to me more probable, plants must have existed in former geologic periods capable of enduring larger amounts of carbonic acid in the atmosphere."

Boehm has also studied the effects of pure oxygen upon the germination of seeds. Seeds moistened and placed in

pure oxygen, at ordinary atmospheric pressure, failed to pass beyond the first stages of germination. When, however, the oxygen was diluted with four fifths of its volume of hydrogen, and likewise when its tension was decreased by the air-pump to about one fifth of the ordinary atmospheric pressure, the seeds germinated as well as in ordinary air. These observations are quite in accord with others lately made by Bert upon the influence of variations in atmospheric pressure upon the vital phenomena of plants. The experiments of Bert showed that the germination of seeds in ordinary air was hindered when the pressure was increased to five atmospheres, and that it failed entirely in an atmosphere of pure oxygen at ordinary pressure; and, finally, that in ordinary air, at a low pressure (a nineteenth to a seventh of one atmosphere), the germination was likewise hindered. Too large a quantity, or too high a tension, of oxygen in the atmosphere seems to be unfavorable to germination of seeds.—*Jour. Linnæan Soc.*, XIV.

DR. HOOKER ON CARNIVOROUS PLANTS.

Dr. J. D. Hooker's recent address to the Department of Zoology and Botany of the British Association had for its subject the carnivorous habits of plants—"our brother organisms." After a brief history of what has been learned of the insect-devouring habits of the *Dionæa* of the Carolinas, the *Sarracenia* of the Atlantic States, and the *Darlingtonia* of California, and of the more widely distributed species of *Drosera*, he adds the results of his own observations of the numerous tropical pitcher-plants (*Nepenthes*) of the East Indian Archipelago. The pitcher is not here a transformed leaf or leaf-blade, as in the other instances, but an appendage developed at the tip of the midrim of the leaf, corresponding to the simple water-secreting gland which occurs at the same point in several other plants. The rim of the pitcher and under surface of the lid are more highly colored than the rest of the plant, and are provided in almost every species with numerous honey-secreting glands, below which is a surface covered with a glass-like cuticle, affording no foot-hold to insects. The rest of the pitcher is entirely occupied with a secreting surface, crowded with spherical glands in immense numbers. The fluid contained in the cavity is collected be-

fore the pitcher opens, and is always acid. Its digestive powers were variously tested, and in all cases the action was most evident, in some surprising. Fragments of meat were rapidly reduced; pieces of fibrine weighing several grains dissolved and totally disappeared in two or three days, and lumps of cartilage of eight to ten grains' weight were half gelatinized in twenty-four hours, and in three days were greatly diminished, and reduced to a clear, transparent jelly. This process, "comparable to digestion," is apparently not wholly due to the fluid first secreted, but it would seem that a substance acting like pepsine is produced, either by the glands or by the cellular tissue in which they are imbedded, after the animal matter is placed in the fluid.

While acknowledging the difficulty in accounting for the origin of these singular deviations from the otherwise uniform order of vegetable nutrition, for the rarity of their appearance, and their occurrence in so widely separated regions, Dr. Hooker refers to other somewhat like processes, as when in the germinating plant the embryo lives by absorbing the nutritive matter stored up in the seed for its use, and as many flowering plants which are destitute of green leaves and unable to elaborate their own proper food grow by absorbing the material of other plants. As respects the origin of the change of habit, the pitcher of Sarracenia may be considered a modified leaf of the water-lily type, which, hollowing in the centre, would allow the accumulation of *débris* of various kinds, and some of the saline solutions resulting from the decomposition would become diffused into the substance of the plant-tissues. So in the case of Nepenthes, the whole apparatus and habit may have developed by natural selection from a fluid-secreting gland at the apex of the leaf. Insects perishing in this secretion would in like manner be to some extent absorbed, and "the subsequent differentiation of the secreting organs of the pitcher into aqueous, saccharine, and acid would follow *pari passu* with the evolution of the pitcher itself, according to those mysterious laws which result in the correlation of organs and functions throughout the kingdom of Nature, and which transcend in wonder and interest those of evolution and the origin of species."

The phenomena as recorded serve at least as one more link uniting the vegetable and animal kingdoms; showing that

the protoplasm of plants is not prohibited from availing itself of food such as that by which the protoplasm of animals is nourished.

REPORT ON THE PLANTS OF THE WILKES EXPLORING EXPEDITION.

Among the gaps that have remained unfilled in the series of reports of the Wilkes expedition has been that on the plants collected by the party, partly in consequence of the failure of Congress to make the necessary appropriations, and partly on account of the death of Dr. Torrey, who had charge of the phenogamous portion. This volume, however, has lately appeared, Dr. Gray having undertaken the work of Dr. Torrey after his death. That part relating to the cryptogamous plants (consisting of the mosses) had been already published in several portions, as well as that on the mosses as prepared by Mr. W. S. Sullivant, that of the lichens by Professor Tuckerman, and that on the algæ by Professors Bailey and Harvey; the fungi by the late Dr. Curtis and Mr. Berkeley.—4 *D*, *October*, 1874, 322.

VEGETATION IN THE SHEEP-RAISING PORTIONS OF SOUTH AFRICA.

It appears from an article in the journal of the Linnæan Society that the introduction of sheep into South Africa has effected great changes in the vegetation of the sheep-raising portion of that region. Besides the naturalization of the cockle-burr (*Xanthium spinosum*), which has spread so extensively that only special laws and the rigid enforcement of penalties have kept it from proving the ruin of the wool producers, the native grasses have succumbed to close cropping, and only shrubby plants remain as the chief resource of the flocks. As a consequence, the rain-fall is said to have become less certain, and to take more frequently the form of thunder-torrents, and the perennial springs are every year less copious. Favored by these changes, and protected by their bitter or poisonous qualities from the sheep, several of the more hardy plants of the adjoining half-desert region are gradually encroaching upon the feeding-grounds, and in some cases have taken possession of large districts.—*Jour. Linnæan Soc.*, XIV., 202–208.

I. AGRICULTURE AND RURAL ECONOMY.

A COVERING OF SNOW AS PROTECTION AGAINST FROST.

Ebermayer gives, in his recent work on the influence of the forests, a table of observations showing the temperature of the earth covered by snow during the very cold weather of December, 1871, in Bavaria. The fact has been generally known that snow is the best possible protection against the penetration of frost into the earth, and that it is the natural protection of seeds, young plants, and other vegetation against frost. It is, however, satisfactory to be able to refer to the exact observations made on this subject by Ebermayer; and, as an indication of the extent to which snow does protect the earth, it may be stated, for instance, that on the 8th and 12th of December the temperature of the air at Vienna fell to $-6.8°$ Fahr., while the temperature of the earth beneath the snow was no lower than $+33.8°$, and four feet below it was 42.8°. So long as the snow lies, the variations of temperature under the earth's surface are very slight.—*Zeitschrift für Meteorologie, November*, 1873, 282.

VIENNA CONGRESS OF LAND AND FOREST CULTURISTS.

Among other features of the International Exposition at Vienna was a Congress of Land and Forest Culturists, represented by delegates from various parts of the world, which had in view, among other objects, the protection of birds useful to the farmer, and the definition of species that might properly come under this category. This subject was brought up by the Swiss minister in Vienna, Von Tschudi, whom we presume to be the well-known naturalist, whose labors upon the fauna of Peru (as published in a large quarto volume) and on the natural history of Switzerland have given him a deservedly great reputation. In the discussion of this paper several persons took part, among them Dr. Alfred Brehm, Mr. Barral, and others. The great importance of birds as the natural protectors of crops was spoken of in the strongest terms, and numerous cases were presented where their agency was decidedly manifest. There was a discussion as to the

measure of protection to which the English sparrow (now a well-known denizen of New York) is entitled; but it was admitted that its benefits far outweigh the injuries that it may occasionally produce.

The general, theoretical measures recommended in connection with the protection of birds were: 1. General instruction in the nature and influence of native animals and birds. 2. Promotion of instruction in natural history by the introduction of an exhaustive manual of zoology and botany in the educational course of public and high schools. 3. Promotion of and an active interest in the rational efforts of societies for the protection of animals. 4. Dissemination of useful knowledge in this direction through free distribution of good books by the government and societies for the general weal. 5. Especially the distribution of a popular, compendious, well-illustrated manual and hand-book of native animals and plants to all foresters, village school-teachers, rural clergymen, and other persons of local influence. 6. Establishment of small collections in schools for the purpose of object-teaching.

The following resolutions were unanimously adopted:

"The International Congress of Land and Forest Culturists, assembled at Vienna, resolve to petition the Austrian government to secure the protection of birds which are acknowledged as useful to land and forest culture by international treaties with other states, under consideration of the following points as bases: 1. The capture and killing of insect-devouring birds are unconditionally forbidden. 2. It is desirable that a special list of the names of such birds as should be protected be published by an International Commission composed of men acquainted with the subject. 3. The capture of birds which are for the most part grain-eaters shall be permitted from the 1st of March to the 15th of September. 4. The capture of birds by means of slings and snares, of whatever kind, is totally forbidden. 5. The taking of eggs and young, as well as the destruction of nests of all birds, with the exception of the injurious species, are forbidden. A list of all injurious birds shall be published by the above-named commission. 6. The public sale of dead or live insect-eating birds is forbidden at all seasons, as well as the sale of all other species of birds during the season

of preservation. This prohibition likewise extends to the sale of the nests of said birds. 7. Exceptions to these resolutions can be made at all times in favor of scientific objects."

AGRICULTURAL PERIODICALS ABROAD.

One of the most interesting indications, as well of the amount of progress in agricultural science as of the appreciation of it, is found in the agricultural literature of this country and Europe, and especially of Germany. In Germany, as nowhere else, are journals devoted exclusively to the publication of abstract investigations in chemistry, physiology, and other branches of science applied to agriculture. In these, and also in others of a different or less scientific character, are published the results of a very large amount of investigation and experiment upon subjects relating to agriculture. In order to gather together and present in a succinct form to the German reader the most important results of this class of work, there was established, early in 1872, the *Central Blatt für Agriculturchemie*, "an organ descriptive of scientific investigations in their application to agriculture." The prospectus for the third year (1874) of this journal shows that it has enjoyed from the start a large and continually increasing success. During the two first years it has regularly gathered material from over sixty periodicals, some English and French, but mostly German. It has published about six hundred abstracts of reports of scientific investigations, and two hundred shorter notices. The subjects treated are grouped under the following heads: Atmosphere and Water; The Soil; Manuring; Animal Production; Vegetable Production; Agricultural Technology; Fermentation, Decomposition, and Decay—the last subject having chiefly to do with the manufacture of fermented liquors. Many of these investigations are of great interest and value. Such are: Studies upon the chemical processes that go on in the soil; the effects of different fertilizing substances upon the plant growth, and of different methods of foddering upon the growth of cattle, the production of milk, etc. It is an encouraging fact to the friends of agricultural science at home that literature of this kind should be so well appreciated, even if it be in a foreign country.

LITHIA IN THE SOIL OF AUVERGNE.

The rarity of lithia in rocks and in mineral waters is well known, as also the supposed part which it plays as a remedial agent in the medicinal qualities of the latter. The recent announcement that Truchot has found this in large quantity in the soil of Limagne, and in the mineral waters of Auvergne, has elicited considerable interest. Indeed, so large is the percentage in the first-mentioned district that an amount varying from 31 to 131 milligrammes of the carbonate of lithia have been found in 100 grammes of earth. A small quantity of this earth moistened with hydrochloric acid gives distinctly, and without any preparation, the characteristic red ray when examined spectroscopically. The same soil, which is remarkable for its fertility, is also rich in alkalies, containing in 100 grammes five or six tenths of one per cent. of potash.

In the course of some experiments upon certain ashes of three different plants found in the vicinity of Lille, Grandeau found that the ashes of colza exhibited indications of sodium and potassium, but not of lithium nor of rubidium; that the beet assimilated the potassium, the sodium, and rubidium; while tobacco accepts potassium and rubidium, with little or no sodium. In Limagne, however, both the colza and the beet take up a small quantity of lithium, 100 grammes of the ashes of each containing about 10 milligrammes of its chloride, while 100 grammes of tobacco ash gave 440 milligrammes.

In reference to the mineral waters of Auvergne, Truchot finds that those of Royat contain 35 milligrammes of chloride of lithium in each liter of water. But he has not yet positively determined the presence of cæsium and rubidium, which are usually associated with those substances.

EXPERIMENTS UPON THE NUTRITIVE VALUE OF CLOVER HAY HARVESTED AT DIFFERENT PERIODS OF GROWTH.

The question as to what is the proper time to mow grass and clover, in order to secure hay of the highest nutritive value, is one of great practical importance. It is well known that when the crop is cut a little before the time of blossom, a smaller amount of hay is obtained than when it is allowed

to stand until it begins to ripen. The earlier cut hay has been believed, however, to contain a larger percentage of digestible nutritive ingredients, so that the nutritive value of the greener fodder may be greater than that of the riper, though its quantity be less.

In Germany, Wagner has lately conducted some experiments calculated to throw light upon this question.

In a field of red clover, the soil of which was of uniform quality, and had received uniform manuring and tillage, and on which was an even stand of clover, three contiguous parcels, of about nine square rods each, were measured off, and the clover mown as follows:

Plot I. Just before the beginning of the blossom, May 22.
Plot II. In full blossom, June 13.
Plot III. Toward the end of the blossom, July 1.

The amount and composition of the different crops are shown in the following table, in which A gives the total amount of the crops and their ingredients in pounds,* and B the percentages of the ingredients:

	A.			B.		
	Plot I. May 22.	Plot II. June 13.	Plot III. July 1.	Plot I. May 22.	Plot II. June 13.	Plot III. July 1.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Amount of hay (air-dry) produced.	85	114	128			
Containing dry substance..........	73	99	112	85.9	87	87.5
Nitrogenous nutritive ingredients	11.8	12.2	12.8	16.1	12.3	11.2
Non-nitrogenous nutritive ingred.	30.6	41.9	46.9	42	42.2	41.9
Crude fibre....................	21.9	36.4	42.8	30	36.7	38.2
Ash (mineral matters)...........	8.8	8.7	9.8	12	8.8	8.7

The author calls attention to the following results of the experiment as shown by the above data:

"Although the amount of the crop, estimated by the weight of dry substance, was greater in III. than II., and in II. than I., yet the total amount of nitrogenous nutritive materials (which are the most valuable ingredients of the fodder) is nearly the same in all; while the percentage of these decreased considerably during the period of growth." From the 22d of May to the 1st of July there was an increase of forty-three pounds in the amount of hay, and of thirty-nine

* By pound is to be understood the German Zoll-Pfund, which is about $1\frac{1}{10}$ lbs. avoirdupois.

pounds in the water-free substance contained therein. But the amount of nitrogenous matter in this latter increased only one pound, while, as compared with the whole dry matter, it fell from 16 to 11.2 per cent.

"On the other hand, the percentage, as well as the total amount of crude fibre, increased very considerably during this period, and at the cost of the other non-nitrogenous ingredients, so that on the 1st of July twice as much crude fibre was harvested as on the 22d of May, while the increase in the amount of the crop was much less."

Numerous trials, made at the German agricultural experiment stations, on the digestibility of different kinds of fodder by different animals, have shown that some of the crude fibre is digestible, and consequently nutritious. On the contrary, a portion of the other non-nitrogenous ingredients is found not to be digested by the animal. In general, the indigestible portion of the latter is found to be about equal to the amount of crude fibre digested. The amounts of crude fibre and of other non-nitrogenous materials are, therefore, approximately accurate measures of the amount of digestible and indigestible non-nitrogenous ingredients of the plant.

In Germany, methods are current for calculating the nutritive values of various fodder materials, based upon the amounts and assumed values of the digestible nutritive ingredients they contain.

Using such rates of valuation, Wagner calculates the values of the three cuts of clover to be as follows:

I.	Harvested	just before beginning of blossom....	78 cts. gold.
II.	"	in full blossom.....................	105 " "
III.	"	toward end of blossom............	95 " "

He concludes therefore that, in view of the fact that increase in weight of clover as it grows older is not accompanied by a corresponding increase in digestible ingredients, and as these ingredients themselves become less digestible as the plant grows older, and, further, as time is secured for after-growth by the early cutting, it is better to harvest the clover when in full blossom than later. He even regards it as a fair question whether it would not be advisable to harvest still earlier, or as soon as the plants begin to blossom. —28 *C*, 1873, 101.

DOES THE FREE NITROGEN OF THE AIR CONTRIBUTE TO THE FORMATION OF NITRATES IN THE SOIL?

Boussingault, long famous for his researches upon the question whether the plant assimilates the free nitrogen of the air, has lately performed some experiments to determine whether the free gaseous nitrogen of the air can take part in the formation of nitric acid in the soil.

It is a familiar fact that saltpetre is found in soil containing alkali and nitrogenous organic matter, from the decomposition of the organic matter, and oxidation of the nitrogen contained therein. The principle involved is the same whether the operation takes place in a nitre bed or an ordinary fertile soil.

The atmosphere is also a source of an immense amount of nitrates for the soil. Under the influence of electrical disturbances, nitrogen, hydrogen, and oxygen are chemically combined, and the compounds thus formed are conveyed by rain to the soil, and thus the latter is fertilized.

It is, however, a question whether the free gaseous nitrogen of the air does not also contribute to the formation of nitrates in the soil, by oxidation and union with the bases therein contained.

To test this question experimentally, Boussingault took two glass globes of one hundred litres' (a little over twenty-five gallons') capacity each, and placed in the bottom of one a quantity of dry earth mixed with quartz sand, and in the other the same materials with the addition of non-nitrogenous organic matter, in the form of woody fibre. The amounts of nitrogen, nitric acid, and carbon in the soils thus formed had been accurately determined by analysis. The globes were tightly closed, and set aside in a cellar, and remained unopened for eleven years. There was, then, in the globes, during this time, organic matter in the earth containing known amounts of nitrogen and nitric acid exposed to the action of air. It was to be expected that the nitric acid would be increased by oxidation of the nitrogen in the organic matter of the earth. The question was whether the free nitrogen of the air would also be taken into the soil and oxidized, and whether this process would be furthered by the oxidation of the woody fibre. A comparison of the total amounts of ni-

trogen in the soil at the beginning and at the end of the experiment would tell whether any nitrogen had been gathered from the air; the increase in the amount of nitric acid would show the amount of nitrogen oxidized, while the decrease in the carbon in the organic matter would be a measure of the oxidation of the latter.

The general results were, that,

1st. In the globe containing the woody fibre the total oxidation of organic matter was greatest.

2d. In each case there was a considerable increase in the amount of nitric acid during the experiment, showing that nitrogen had been oxidized. The oxidation was less, however, in presence of the woody fibre, showing that the greater oxidation of organic matter had not favored the oxidation of the nitrogen.

3d. The total amount of nitrogen in the soil in each case did not increase; whence it appears that the increase in nitric acid was at the expense of the nitrogen in the organic matter, and that there the free nitrogen of the inclosed air did not contribute to the formation of nitric acid nor other nitrogenous compounds in the soil.

This failure of the free nitrogen to become oxidized was not dûe to a lack of free oxygen in the air, since less than one fourth of the latter was consumed during the experiment. Nor was it to be ascribed to lack of bases with which the nitric acid could combine, since analysis showed that enough of the latter was present to combine with three or four times as much as was present at the end of the experiment.

"It results from these experiments, therefore, that the free nitrogen contained in a confined portion of the atmosphere, and one which is not renewed, can not take part in the formation of nitric acid which takes place in the soil. Under the circumstances named, nitrification took place only at the cost of the humus substances which exist in every fertile soil."

This test forms a very interesting supplement to the classic researches of the same savant upon the question whether plants assimilate free nitrogen from the air. The results of these latter, which have been confirmed by experiments of Lawes and Gilbert in England, show that plants do not assimilate the uncombined nitrogen of the air. It appears

probable, therefore, that, as well in the soil as in the atmosphere, nitrogen must first have been combined with other elements before it can be efficient as a fertilizer, and that the soil has no power of bringing the free nitrogen of the air into such combination.

NEW GUANO DEPOSITS OF PERU.

It will be of interest to our agriculturists, as well as to manufacturers of artificial fertilizers, to learn that the new guano deposits of Peru are said to be very decidedly superior in commercial value to those of the Chincha Islands. Professor Raimondi, of Lima, has lately made a report to the government, in which he makes the following remarks:

"The guano of the province of Tarapaca is dry and powdery; some specimens not containing 15 per cent. of water, among which thirty-three seemed about equal in that respect to the Chincha guano. The guano of the south of Peru has, in this, an advantage over that of Guanape, which is pasty, and not so easily spread over the soil. The guano of Tarapaca, from its dryness, makes the uric acid and other nitrogenous principles less apt to be decomposed. In guano more abounding in humidity those elements become transformed into carbonate of ammonia, which, being volatile, escapes during transportation. This guano, although abounding in ammonia, has little smell, and from this fact might be judged of less value; the want of a strong ammoniacal odor being due, not to lack of ammonia, but from two different causes. 1. Being very dry, as before observed, the formation of carbonate of ammonia does not so readily take place. The presence of a strong ammoniacal smell indicates that the ammonia is being given off, and this condition, instead of being favorable, is prejudicial. 2. The ammonia in this guano is combined in great part with phosphoric acid, under the form of phosphate of ammonia, which is a fixed salt, and emits no smell. The association of ammonia with phosphoric acid gives a greater importance to this article, because those two most valuable elements of all kinds of manure existing in a soluble state are more easily taken up by plants, a circumstance which makes the guano of Tarapaca preferable and superior to all others yet known. In these guanos, phosphoric acid in a soluble condition prevails to the extent, in many

samples, of 10 per cent. and even to 12 and 13 per cent., while in that of the Chinchas it does not go beyond 4 per cent.

From the preceding results, it is evident that if, in the province of Tarapaca, some of its guano is poor in ammonia, there are others equal to the best guano of the Chinchas, and even more valuable than the latter from the greater proportion of soluble phosphoric acid they contain. The most abundant deposits, such as those of the Pabellon de Pico, Patache, Huanillos, and Point Lobos, are also those of a superior kind of guano.

Of the specimens from Point Lobos, one contained only 0.81 per cent. of ammonia, another 3.15 per cent.; another the extraordinary amount of 15.67 per cent. The inference was that these three specimens were taken at different depths, the deepest abounding most in ammoniacal salts. A bottle was received from Patache filled with muriate of ammonia, very pure, and of fibrous structure. Its presence would go to show that the guano of these deposits may be expected to improve, in proportion to the depth from which it is extracted. Of the thirty-three specimens from different points analyzed by the Professor, the value ranges from £1 16*s.* to £16 a ton, the latter being from Pabellon de Pico.—*Panama Star and Herald, May* 1, 1874.

FOSSIL PHOSPHATES OF BELLEGARDE.

Risler gives an account of investigation of the fossil phosphates of Bellegarde, in the department of Ain, in France, near the Swiss boundary. He found in a sample 47½ per cent. of the basic phosphate of lime, corresponding to 21.7 per cent. of phosphoric acid. By treatment with sulphuric acid, a super-phosphate was obtained, with 20.3 per cent. of soluble phosphoric acid, which is a large amount. Such a fossil phosphate as this, and occurring in considerable quantity, must prove very valuable.—28 *C*, 1873, XI., 316.

AGRICULTURAL VALUE OF ANTHRACITE ASHES.

In the *Bulletin* of the Bussey Institution of Harvard University, lately issued, are accounts of several series of investigations undertaken by Professor Storer and his assistants, which are not only interesting and valuable in themselves,

but also very encouraging in the prospect they give for the cultivation of agricultural science in this country. Among these are a number of experiments "on the agricultural value of the ashes of anthracite." In these experiments, pots were charged with ashes of Pennsylvania anthracite coal, and planted with oats, barley, buckwheat, beans, maize, etc. In some cases they were watered with rain-water alone; in others, with solutions of nitric acid or phosphoric acid, combined with lime, magnesia, potash, ammonia, or of several of these together. The ashes used were free from wood ashes, thus differing from those commonly produced in stoves and furnaces.

Raised in the ashes with rain-water alone, says Professor Storer, "none of the plants really prospered. The beans and pease grew to a considerable height, but it was plain that the matter of which the new parts were formed came chiefly from the older parts. The nitrogen, at all events, needed for the formation of new leaves and stems, was apparently the same that had taken part in the formation of the first shoots from the seeds." When, however, nitrate of lime was substituted for the rain-water with which the plants had been watered, the plants, before stunted and dying, became thrifty, and in time exhibited a luxuriant growth. The yield of dry substance, when the plants were watered with nitrate of lime, was in several cases over fifteen times as much as when pure water was used. "It is plain that the ashes used must have contained appreciable quantities of phosphoric acid and potash, as well as the lime, magnesia, sulphuric acid, and iron, which are necessary for the growth of plants, for on the addition of nitrogenized salts to the ashes abundant crops of buckwheat and barley could be produced. . . . The addition of potash and phosphoric acid did little or no good, while sulphate of magnesia seemed to do harm."

The question arose whether the pure anthracite coal-ashes were better, in respect to their contents of potash and phosphoric acid, than ordinary sand. To get light upon this point, experiments quite similar to the above were made with ordinary pit sand, such as is common in the neighborhood of Boston; with pure white quartz sand, such as is used in making flint-glass; and with New Jersey green sand marl.

The pure quartz sand was found to contain very little nu-

tritive materials; while the ordinary pit sand was superior to the ashes of the Pennsylvania white-ash coal, as regards the amount of potash and phosphoric acid contained in fit form for plant-food. The largest yield was obtained from the green sand, with solution of nitrate of potash.

This series of experiments shows that, while the ashes of the Pennsylvania white-ash coal examined do contain appreciable quantities of potash and phosphoric acid in condition fit for the support of plants, they are, nevertheless, inferior in this respect to an equal bulk of good pit sand from Massachusetts. It is interesting to note, in all of the experiments, how readily the, comparatively speaking, insoluble rock phosphates of the sands are put to use by plants that are duly supplied with potash and nitrogen, and other kinds of plant-food, provided the soil is kept moist. The experiments with the New Jersey green sand illustrates very clearly its fertilizing value, both as regards potash and phosphoric acid, as well as the importance of using a nitrogenized manure, in order that it may produce its proper effect in field practice.

Chemical examinations were made of the ashes used, and their absorptive power was also studied.

On the whole, this series of experiments is quite interesting, and it is to be earnestly hoped that investigations of this and similar character may be encouraged, so that we in this country may no longer be so far behind the Europeans, and particularly the Germans, in investigations in agricultural science.—*Bull. of Bussey Institute*, 1874, I.

COIGNET'S PROCESS FOR THE PREPARATION OF ANIMAL MATTER FOR THE MANUFACTURE OF FERTILIZERS.

Without deciding upon the value of samples of fertilizers presented by Coignet, a committee to which the matter was referred recommends the process employed in their manufacture, and suggests that it may find many applications, and render possible the utilization of many substances for fertilizers that have hitherto been unemployed. Thus horns, hoofs, hair, leather scraps, woolen rags, etc., although rich in nitrogen, and other fertilizing matter, have hitherto had no special value, on account of the difficulty of pulverizing them, and their slowness of decomposition in the soil. By Coignet's process such substances can be pulverized and decomposed

in as short a time as stable manure. To this end they must be placed in a drying-chamber of sheet-iron, having a capacity of at least twenty-six cubic yards, and supplied with a door at the top for filling, and others on the side below for removing the dried materials. There must also be a perforated floor of brick-work, from eight to sixteen inches above the bottom. The lower part of the chamber communicates by means of a wide sheet-iron tube with the chimney of the establishment, or some draught, and a rectangular furnace, for the consumption of coke, adjoins it, with its chimney entering the top of the drying-chamber. The hot air and products of combustion thus pass through the chamber from top to bottom, its doors being carefully luted tight, and the doors of the furnace above the fire-chamber being open, so that as large a volume as possible of heated air (not above 300°) may be thrown into the chamber. When the material has all reached this temperature, the furnace is freshly filled, and its doors closed, so that the fire is simply kept alive; and a stream of steam is then passed into its chimney, which mingles with the consumed air, and passes through the chamber at a temperature of 300° to 320°. After such treatment for several hours, the material, although somewhat swollen, is perfectly dry, and pulverizable without trouble, and without loss of nitrogenous matter. When cold, it is crushed by rollers and passed through sieves. So accurate is the preparation of mixtures from this product that the manufacturer guarantees the quantity of nitrogen and phosphates.—14 *C*, CCX., 118.

HAY-CAKES FOR HORSES.

Hay tablets, prepared in the following manner, have been employed in France for some time, as a convenient and portable feed for horses: Hay and straw, very finely cut, are well mixed with crushed oats or rye, and moistened with a solution of rapeseed or linseed oil-cake, and the mass again well worked, and then formed into tablets under pressure.—9 *C*, *February*, 1874, 28.

EFFECT OF THE ADDITION OF FAT TO RAW FEED FOR SHEEP.

Experiments upon sheep by Hofmeister, of the Dresden experimental station, afford the following conclusions: (1.)

Fat incorporated with the raw feed was without effect upon the digestibility of the raw fibre. (2.) A dose of three quarters of a pound of fat to 1000 pounds' live weight, and 18 to 20 pounds of organic matter in the feed, increased decidedly the digestibility of the organic matter of the feed in general, and especially of the proteine matter of the raw feed, and of the non-nitrogenous extractive matter. (3.) This increased digestibility of the nutritive matter was only true of clover hay, and not of meadow grass. (4.) It appeared on calculation that clover hay, which loses, as was proved experimentally, in digestibility by being stored for a month, and more for a longer time, can not then be restored to its normal condition, in this respect, by the addition of oil, the proteine matter being rendered as digestible as in well-cured hay, but the non-nitrogenous extractive matter remaining ten per cent. less digestible. (5.) The oil added seemed in the highest degree digestible. (6.) The digestibility of raw feed, clover hay, is, however, not so materially heightened by the addition of oil that it would pay to add it for this purpose; but since fresh clover hay possesses almost as high a degree of digestibility as (and in some cases even higher than) old hay treated with oil, it is decidedly advisable not to store such hay longer than necessary before feeding it. (7.) Increase of the dose of salt from 964 grains to 1928 grains per 1000 pounds of weight of the sheep seemed injurious to the digestion of nutritive matter, while it caused a larger consumption of feed. (8.) A better or worse effect of the feed, as indicated by an increased or diminished increment of weight of the animals, on the administration of oil or salt, could not be recognized from the experiments.—8 *C*, *April* 30, 1874, 158.

INFLUENCE OF FOOD ON THE MILK PRODUCTION OF GOATS.

Our late journals bring accounts of the continuation of the experiments performed under the direction of Stohmann, at the experiment station at Halb, in Germany, on the influence of the food upon the milk production of goats. The results are, in the main, in accordance with those of previous experiments. The composition of the organic substance of the milk was not essentially altered by changes in the composition of the food. "The milk production was influenced by the amount of water consumed. This observation, which is in

accordance with agricultural experience, shows the difference between the fattening and milk-producing processes." "The amount of milk production is dependent upon the individual peculiarities of the animal, and upon the duration of period of lactation." The very interesting observation was also made that the decrease in the amount of milk during the period of lactation may be prevented to a considerable extent by an increase in the amount of albuminoids in the fodder.—28 *C, January*, 1874, 26.

REMOVAL OF SMELL FROM HOG YARDS.

Professor Horsford has lately been making experiments in reference to the abatement, and if possible the removal, of the nuisance caused by the establishment of extensive hog yards in the vicinity of cities, with especial reference to those at present near Boston. It may create a smile of incredulity on the part of our readers to be informed that at the present time Boston, as a pork-packing centre, is second only to Chicago, having long since distanced Cincinnati and other Western towns in the race, and that probably, within a comparatively short time, it will outrank even Chicago. This is due to the facilities secured by the Boston merchants for the transfer of live stock to the East, rather than the packed pork, and to the very complete and efficient labor-saving arrangements for doing the work on a large scale, and at a very trifling cost.

Here, however, as elsewhere, the odor developed by the concentration of so many living hogs has become very disagreeable to the neighborhood, and Professor Horsford, as an expert, has been called upon to devise a remedy. He reports that he has succeeded in preparing a liquid, which, when sprinkled to the amount of about a pint to each animal upon the hogs and their surroundings, will entirely remove the peculiar odor, so as to make it inappreciable. This is also to be applied to the floors and sides of the cars in which the animals are transported. When once within the pens, and a supply of charcoal spread upon the floor, the emanations are almost completely overcome.

It is now proposed to thatch with straw the board walls of the space where the hogs are last handled before dropping into the scalding-tank. This will reduce the noise to a mini-

mum, and render it almost inaudible beyond the walls of the inclosure. Professor Horsford thinks that the problem of the possibility of an extensive inoffensive slaughter-house for swine is satisfactorily solved.—*Boston Advertiser*, *January* 7, 1874.

EFFECT OF ADDITION OF PHOSPHATE OF LIME TO FOOD OF LAMBS.

Numerous comparative experiments to solve the above problem were made by Dr. Hofmeister, by feeding to one lot of lambs, six weeks old, hay and potatoes alone, and to another phosphate of lime in addition. Although the phosphate diet seemed to produce a better appetite, yet, since greater increase in weight did not seem to accompany increased consumption of food, it was concluded that at least by the moderate feeding employed no peculiar effect in increasing the live weight could be ascribed to phosphate of lime. The ratio of live weight to dead weight was found upon slaughtering to be the same in both cases. The bones of those not treated with phosphate were for the most part richer in fat, but the phosphate seemed to be without perceptible effect upon the amount of lime or phosphoric acid in the bones. The experiments tend to substantiate the opinion of Haubner that the addition of phosphate of lime has no influence upon the formation of bone nor flesh, unless the usual food is actually deficient in it. The animals treated with phosphate digested on an average 37.5 per cent. more phosphoric acid and 23.8 per cent. more lime than the others. Experiments with sheep two years old with superphosphate of lime showed that with 150 grains administered per day, 51.1 per cent. of its phosphoric acid and 41.7 per cent. of its lime were digested; and of 300 grains, 31.6 per cent. of its phosphoric acid and 64.71 per cent. of its lime were digested. No injurious effects were perceived.—28 *C*, *Sept.*, 1873, 151.

FEEDING ANIMALS WITH FLESH FOOD.

Pettenhoffer and Voit have lately investigated the effect of feeding animals with flesh food, the experiment being tried upon a dog, provided with various known quantities of flesh and fed for a certain period; and, during each diet, placed for one or more days in the respiration apparatus, every thing

taken in and run off being noted. It was found that a fat, well-fed body will oxidize more fat than a lean one, and that, as the body becomes fatter, rather less fat is digested. Albumen is far more readily oxidized than fat: the addition of fat to an albuminous diet scarcely diminishing the amount of albumen oxidized. On the other hand, the addition of albumen to a fatty diet diminishes the oxidation of the fat and greatly increases the amount of fat stored up. If a liberal albuminous diet be long continued, or follow a very low diet, fat is produced from the albumen; but if the same diet follow one rich in fat, the animal for a time loses fat. The authors consider that fat is in all cases produced from the albumen of food, but it is generally burned, and not deposited. Fattening is best attained by beginning with a liberal nitrogenous and medium fatty diet, and when the animal frame has sufficiently increased, giving more fat and less albumen. The amount of oxygen taken up has no relation to the kind of diet, but rather to its quantity. A maximum consumption of oxygen is not possible without the circulating system being largely developed, which implies liberal albuminous diet. —21 *A*, *October*, 1873, 1047.

INTRODUCTION OF PRAIRIE CHICKENS INTO THE EASTERN STATES.

Quite an extended movement is taking place, having for its object the introduction of prairie chickens, or the pinnated grouse, from the West into the scrubby lands of the Eastern States, and especially of Long Island. An augury of success is furnished by the fact that, when the country was first discovered, these birds were extremely abundant in many parts of New Jersey, Pennsylvania, Long Island, and the islands and coasts of the New England States as far as Cape Cod. They have, however, been almost entirely exterminated, a few only existing in the mountain region of Pennsylvania, in Martha's Vineyard, and possibly in parts of Long Island. According to a memorandum in *Forest and Stream*, two pairs of grouse were obtained about five years ago, and placed in the vicinity of Snow Hill, Maryland. The first season they raised twelve or thirteen young, and it is now estimated that, in that section of country, the number has risen to about two thousand. The residents in the neighborhood of this experi-

ment take great interest in it, and are very particular not to allow any molestation. The passage of a law was also obtained forbidding their being killed for five years.

English sportsmen are now taking measures to introduce the same species into Great Britain and Ireland, with what success remains to be seen.

REARING THE AMERICAN WILD TURKEY IN FRANCE.

Mr. Edgar Roger has paid much attention to the rearing of the American wild turkey in his park near Nandy, in France, and has met with great success in managing them. They are allowed to run free in a walled park seventy-five acres in extent, and when their wings are untrimmed they are in the habit of going off into the surrounding country, sometimes to the distance of many leagues, seeking their food, but always returning at night to a particular tree selected by them as a lodging-place.—10 *B*, *May*, 1874, 370.

THE BEST INSECTICIDES.

The injuries caused by insects to certain crops are in many cases only to be prevented by the use of poisons; and it is a matter of much importance to select those which shall be most efficient while at the same time least likely by their color and character to involve danger from their use. The prevention of the ravages of the Colorado potato beetle, which have been so serious within the last two years, can, it is said, only be accomplished by the application of Paris green or Scheele's green, an arsenite of copper; and the practical success of this treatment has induced the United States Agricultural Department to invite experiments as to its effect upon the cotton worm. It is estimated that a loss of not less than a quarter to a half million bales of cotton takes place annually from this cause alone, which, at $100 per bale, would amount to from $25,000,000 to $50,000,000.

A circular has accordingly been transmitted by the Department to its correspondents in cotton-growing countries, and the monthly report of the Department for November contains a digest of the replies to the queries contained therein. The general conclusions to which the department arrives are that the use of one part of Paris green, pure and unadulterated, mixed thoroughly with twenty-five or thirty

parts of flour (damaged flour being good enough), answers perfectly well, and has proved of such utility as in many cases to have saved the crops.

Paris green or arsenic, mixed with water, and sprinkled over the plants, has also been used with satisfactory effect. The latter application should be made moist, and before using the former it is desirable that the plants be wet by rain or artificially, in order to cause the dust to adhere to the leaves. The poisons should be applied on the first appearance of the caterpillars, and also as soon as possible after the second crop of worms is seen. Caution must be exercised to be on the windward side of the plant when dusting the poison upon it, and not to permit the cattle to feed on the foliage.

Large flocks of turkeys have been found very efficient in destroying both the cotton and the tobacco worms.—*Rep. Agric. Dept., December*, 1873, 575.

DALMATIAN INSECT-POWDER.

It is stated by Professor Landerer that the common *Chrysanthemum leucanthemum* has long been employed in Dalmatia for the preparation of a powder similar to Persian insect-powder, and that this widely diffused weed is now largely employed in Germany for the same purpose, and, with the *Chrysanthemum segetum* forms a perfect substitute for *Pyrethrum carneum* and *roseum*, from which the Persian powder is prepared. These facts may be of sufficient importance to justify further experiments with these plants, since Dalmatian insect-powder has recently been found very effective against parasites on sheep and cattle, one pound of it being equivalent in this respect to a pound of arsenic. The Dalmatian powder is now regularly quoted in the druggists' lists, and at a higher figure than the Persian.—28 *C, April*, 1874, 315.

EFFECTIVE INSECT-POWDER.

Powder prepared as follows from the plant used in making the so-called Persian insect-powder is recommended as less liable to failure than the commercial article, and not only as very effective against moths, fleas, bed-bugs, and poultry vermin, but also as a useful internal remedy against worms, when

administered in a weak infusion. Seed of the plant known scientifically as the *Pyrethrum roseum*, and which is obtainable from large seed-dealers, is to be sown in May, not too thickly, in a well-cultivated bed; which will develop large stalks by fall, if the weeds are kept down, although it seldom blooms before the next May or June. The flowers are to be plucked as they become fully developed, and the yellow disk-flowers separated from the red rays and calyx, thoroughly dried in the shade, and finely pulverized. Flowers can be plucked even in the autumn, so that a few beds will produce a considerable quantity of the powder, and as the plant is perennial, it can be propagated by dividing the old stalks in the fall. Since it is indigenous to the Caucasus, it is not very sensitive to winter temperature.—8 *C, August* 14, 1873, 273.

NEW FORM OF BLIGHT ON FOREST TREES.

A new form of blight is reported as attacking beech-trees in Westphalia. A snow-white, downy substance appears upon the bark and gradually covers the tree, sometimes producing death. It is shown by the microscope to consist of fine threads, among which appear great numbers of small insects by which these are secreted. It has the properties of wax, having nearly the composition and melting-point of Chinese wax. It is, in part, saponified by potash, the soap yielding an acid, with a melting-point of 51.5°. The unsaponified portion melted at 140°–145°, and seemed to be rich in carbon.—*Landwirth. Versuch-Stationen*, 1873, XVI., 198.

EXTERMINATION OF TREE-BEETLES, ETC.

An old, headless barrel, smeared internally with tar, having a properly protected lamp in the bottom, will collect large quantities of beetles during a night.—9 *C, July*, 1873, 108.

DESTROYING MAY-BUGS.

A French writer gives the following method of destroying the May-bug, or cockchafer, on a large scale, his captures amounting to ten or fifteen gallons in a night. For this purpose he smears with tar the inner surface of an old barrel, one head of which has been removed, and at twilight he

places near the bottom of the barrel a lighted lantern. Insects of all kinds are attracted by the light, and in flying around it they strike against the sides of the barrel, when their wings are gummed, and they fall to the bottom. These may then be thrown into boiling water or otherwise destroyed, and they can, indeed, be made to serve a useful purpose as a manure. If a similar method of destroying the moth of the canker-worm, which is so fatal to the apple crop in New England, can be successfully applied, it will prove much more simple, as well as more effectual, than any remedy hitherto employed.—3 *B*, *April* 2, 1874, 611.

SULPHIDE OF CARBON FOR PHYLLOXERA.

Among other remedies lately suggested for the destruction of the terrible *Phylloxera*, or grape-vine louse, is that of M. Monesteux, in the application of sulphide of carbon. Two or three holes are to be made by means of an iron bar at the root of the vine, and one or two ounces of the liquid placed in each, the holes being then filled from above with earth. The odor of the sulphide penetrates to the roots and affects the plant above, and, according to the writer, brings about the destruction of every insect in the course of a week or ten days, without injury to the vine. The remedy needs to be tested by long-continued trial, as the insect is one that it is extremely difficult to exterminate by any treatment.—18 *B*, *September* 6, 1873, 224.

THE PHYLLOXERA AND ITS PARASITES.

M. Planchon, who was sent to America some months ago by the government of France for the purpose of investigating the natural history of the *Phylloxera*, or grape-vine louse, in the country believed to be its native home, and from which it was transplanted to Europe, has recently reported the results of his inquiries to the Academy of Sciences of Paris. While here he spent much time with Mr. Charles V. Riley, the State Entomologist of Missouri, to whom we owe a great deal of our knowledge of this destructive insect. Planchon communicates to the Academy what he considers three important observations; first, the absolute certainty that the American *Phylloxera* is the same insect, specifically, as that which destroys the vines in Europe; second, that certain

varieties of American vines resist the attacks of the insect; third, the existence of an *acarus* which pursues the *Phylloxera* for food, even into the depths of the soil, and destroys it. Planchon carried back with him some specimens of this *acarus*, the acclimation of which he thought would produce important results.—6 *B*, *October* 20, 1873, 871.

PHYLLOXERA THE RESULT, NOT THE CAUSE OF THE VINE DISEASE.

M. Guérin Méneville, in a communication to the Academy of Sciences of Paris, takes the ground that the *Phylloxera* (or grape-vine louse) is not the cause of the vine disease, but simply an accompaniment of it, the pathological condition of the vine permitting an enormous multiplication of the insect. Until quite recently, the *Phylloxera* has remained almost unappreciated, on account of its diminutive size and its retired life; but in the diseased state of the plant it is multiplied to such an extent as to make itself manifest to the notice of all. In this view, all efforts at removing the evil by applications to the insect must necessarily be fruitless, and only those which serve as manures or stimulants to the plant itself will be of any avail.—1 *B*, *December* 21, 1873, 214.

PROTECTION OF RABBITS IN ENGLAND.

The Game Law Committee of Parliament has recommended that the protection given to rabbits by the game law should be withdrawn, excepting in warrens and small inclosed spaces, in view of the great injury done by these animals to the cultivated lands, in which they are alleged to destroy more food than they are worth. It is difficult to realize the number of hares and rabbits annually killed, and used for food or for their fur, in the United Kingdom; but, according to *Land and Water*, the aggregate reaches 30,000,000, furnishing about 40,000 tons of food, and the collection and manufacture of the skins supplying employment for many thousands of people. Besides these, large numbers of rabbits are imported from abroad. The skins are used for making felt, from which hats are manufactured, and they are also dyed and used for cheap furs.

It is maintained that a comparison as to the relative pecu-

niary value of rabbits and sheep, upon all the light soils near the sea-coast, shows that the rabbits are very much more valuable, since they eat various kinds of grasses which sheep never touch, and will also feed on dandelions and roots; and while the sheep take off the top of the vegetation, the rabbits eat the rest, so that both can be cultivated in the same region, although it is more profitable to confine attention exclusively to the rabbits.—2 *A*, *December* 6, 1873, 460.

DESTRUCTIVENESS OF RODENTS IN CALIFORNIA.

It is difficult for those living in the older portions of the United States to realize the extent of the losses experienced by agriculturists in California from the ravages of the various rodent mammals which abound in that state, especially the gophers and so-called ground-squirrels.

The gopher is a large species of pouched rat, which makes extensive burrows, from which it seldom emerges. It has a counterpart in a larger species, bearing the same name, in Illinois, where also it is sometimes called the pouched rat. Another species is called the salamander in Georgia and Florida.

The ground-squirrels are very different from the animal bearing the same name in the Eastern States. It is a species larger than the common gray squirrel of the East, with a tail nearly as long, but much less bushy, and occurs in large communities, living in burrows more or less thickly aggregated. The ground-squirrel is known as *Spermophilus beecheyii;* while the gopher is the *Thomomys bulbivorus.*

A convention of agriculturists was held in October last to discuss the best methods of destroying these animals (the squirrels especially), and was attended by delegations from a large portion of the state. On this occasion it was remarked that the plan of offering local bounties had proved entirely inadequate, the expense being enormous, and very little benefit resulting; and it was considered necessary to invoke the aid of the state in the adoption of some more comprehensive method than had hitherto been employed. The law already enacted by the state is considered harsh and impracticable, and further legislation is desired.

According to statements presented at this meeting, the average loss from the ravages of the squirrels, in Contra Costa

County alone, amounted to one dollar per acre; one farmer estimating his share at over $1000. In addition to the injury to the grain itself, the thinning-out of the grass by the destruction of the seeds is also an important element in the case. The method usually adopted for keeping the squirrels in subjection is the application of poison of some kind; several gentlemen present at the conference stating that phosphorus was the best for the purpose. It was thought that if a concerted action were entered upon the evil could be greatly reduced, if not entirely removed, in the course of a few years. The best time for such action was thought to be October, after the rains, when the animals were hungry, and readily devoured any bait put in their way.

The applicability of the "Vermin Asphyxiator," an article recently patented in Great Britain, and already introduced into this country, may here be suggested. This consists, essentially, in burning sulphur and other noxious substances in an air-tight box, and passing the fumes, by means of a fan, through a tube into the abodes of the vermin. It is stated that nothing has proved so satisfactory for the destruction of rats in buildings and outhouses, especially as the sulphurous-acid gas generally used has an important function as a disinfectant and deodorizer, and tends to prevent the annoyance caused by the decay of the animal. In the case of ground-squirrels and gophers, it would seem only necessary to stop up a certain number of holes, so as to retain the gas in the burrows among the animals for a sufficient length of time to cause death, asphyxia occurring in a very short time. The same method is also much used at present as a disinfectant for vessels, rooms, and buildings, and performs its work most efficiently and satisfactorily.

RAT POISON.

The following method of preparing poison for rats is said to be more effectual than moistening grain with a solution of strychnine: Make a clear solution of arsenite of potash, by boiling in a large iron kettle one part of white arsenic, one of carbonate of potash, and 25 of water, stirring the whole well together; add 25 parts of water, and introduce, while warm, 50 parts of barley, wheat, or oats, stirring frequently during 24 to 36 hours; then heat the grain and stir it with

a paddle until it appears dry externally. For use in the house it may be advisable to color the grain by adding one five-hundredth part of liquid fuchsin. Clean the kettle after use by scouring with lime. In most cities, however, the arsenite of potash can be obtained ready made, and thus the trouble and danger of preparation is saved.—15 *C*, 1873, 204.

EFFECT OF TEMPERATURE ON THE CREAMING OF MILK.

The results of a series of experiments, carried on through several months, by exposing different portions of milk in pans to temperatures of 40°, 57°, and 74°, and determining the amount of fatty matter still present after various times of exposure, are embodied in a report by Schubert, from which it appears that the separation of fatty matter from the milk was most rapid at 40°, but that it was more rapid at 74° than at 57°, the separation being more complete at 40°, in 18 hours, than it was at 57°, after 30 hours. After 24 hours at 40°, only 0.296 per cent. of the fatty matter remained in the milk; and while diminution of it continued to from 30 to 36 hours, it was so slight as to have no practical importance. Tests made on a large scale of Schwartz's method of immersing the milk in deep vessels in ice-water, showed that it produced the largest yield of butter for equal measures of milk; and also that sweet cream afforded more butter than sour cream. The method possesses the additional advantage that the milk never sours, can be preserved several days in ice-water without the least injury, and will bear transportation to a considerable distance before becoming warm enough to change. Cheese made from it is also much better, and less liable to spoil in keeping; and since butter made from sweet cream contains less milk-sugar and caseine, according to the analyses made, it is consequently less liable to become rancid.—28 *C*, *January*, 1874, 65.

PREPARATION OF CONDENSED MILK.

The process of Professor Trommer is essentially as follows: The milk from washed udders, after being strained and boiled over a free fire, is again strained through a fine tin strainer into shallow evaporating pans of heavy tin, and evaporated on a water-bath, with continued stirring with a wooden paddle, after the addition of from 3 to 3½ ounces of refined sugar for

each quart of milk, in form of a sirup, prepared by boiling it for some time with half its weight of water, skimming, straining it through flannel, and cooling it to 167°. The temperature during evaporation is not allowed to rise above 189°. When sufficiently concentrated, as indicated by its dripping from the stirrer in adherent masses, tin cans of from 1 to 2 pounds' capacity, previously cleansed with soda-lye and heated well for a few seconds, are filled completely with it, and the space left by contraction, on cooling to from 66° to 73°, is filled up with hot, concentrated, purified sugar sirup, and the can is immediately closed with a cap, and the joint covered with hot flour-paste, and then with a strip of paper similarly coated. Ten to eleven ounces of this preparation, with the addition of a quart of water, are said to be equivalent in value to a quart of pure milk. While analyses of several samples of condensed milk of the same specific gravity, by Professor Moser, showed that one was much richer in the proper ingredients of milk, and the other consequently in sugar, he does not consider it advisable to carry the concentration too far, as may be necessary to produce an article of the first kind, since the milk is apt in such cases to acquire a tallowish taste, so frequently noticed in condensed milk.—28 *C*, *April*, 1874, 299.

EFFECT OF FEEDING ON THE COLOR OF COCOONS.

The art of silk-culture is likely to be materially advanced by the discovery of Taillis (if it be true) that when the worms are fed on vine-leaves the cocoons are of a magnificent red, and if lettuce be used, they become an emerald green. Another experimenter has obtained silk of a beautiful yellow, a fine green, and then again violet, by feeding with lettuce or white nettle. Taillis remarks, however, that the worms must be fed on mulberry-leaves when young, following with other leaves during the last twenty days of the larval stage of life. —16 *A*, *October*, 1873, 543.

ARTIFICIAL HATCHING OF SILKWORMS' EGGS.

A very curious discovery has been communicated by Susani, an Italian scientist, to the French Society of Agriculturists, to the effect that the hatching of silkworms' eggs may be artificially hastened by friction. The process consists, essentially, in brushing the eggs vigorously, for ten or twelve min-

utes daily, with a moderately hard brush, made, preferably, of coarse grass. In less than fifteen days the eggs thus treated will hatch out, with a product as healthy as that obtained in the usual way. A small proportion of the eggs may prove refractory to this novel treatment, and yet, in the spring, even these will hatch out earlier than those which have been left to themselves.

Susani performed a series of experiments upon about four fifths of an ounce of silkworms' eggs, beginning on the 1st of August. They were brushed for ten or twelve minutes daily, and only about one tenth of the whole number was lost. The first hatchings occurred on the 14th of the month, and were succeeded by others for seventy-two consecutive days; the largest number hatched on the ninth day following August 14 giving 112 worms. After this date the hatchings decreased. From August 17 to September 1, 932 worms were hatched out. From August 14 to November 14, 1200 were born. Those which came out during the first fifteen days were raised and prospered perfectly, although it was found that the worms earliest hatched were not by any means the healthiest. No satisfactory hypothesis has yet been proposed to account for the curious effect thus produced by friction upon these eggs; but new experiments are in course of execution, and may lead to something more definite. Probably the discovery will be found to have important practical bearings; but much remains to be done in order to render it available.—13 *B, March* 21, 1874, 250.

REMOVAL OF BURS FROM WOOL.

The United States Economist for November 29, 1873, contains a communication from Mr. Thomas Crossley in reference to an improved method of removing the burs from wool, which he claims as constituting a very great advance in the manipulation of this staple. Not only is the wool made thoroughly clean by the process, but it is also bleached perfectly white, however yellow may have been its previous condition; and, thus prepared, it will receive any desired color in a shorter time and at less expense than usual, in consequence of the uniform condition in which it is left by the treatment.

By Mr. Crossley's process the wool is first simply scoured and washed clean in the ordinary manner, and, after removing

the water by means of the hydro-extractor, it is spread upon racks to a thickness of from four to six inches, and submitted to a gas generated from a combination of materials, which serves to entirely decompose the claw, or beard, of the bur, or other vegetable matter or scurf mixed with the wool; so that all the burs, grass seeds, and other foreign substances, when submitted to the action of the bur-picker, are at once removed, and the wool is left in a soft and elastic condition. The labor and material required to produce this result are trifling: the spreading of the wool to receive the gas being about the only addition to the work that is usually required. —*U. S. Economist, November* 29, 1873.

RAIN-FALL AND FORESTS IN THE WEST INDIES.

Mr. F. Hubbard, in some remarks on the relation of rain-fall and forests in the West India Islands, states that the diminution in rain-fall in the island of Santa Cruz is noticeable, and that in the past twenty-seven years the effect is perceptible in the gradual change from fertility to barrenness. Every plantation newly swallowed up by the onward march of desolation augments the cause, and renders the arrest of the evil more and more hopeless. The movement is from the east and toward the west, every few years an estate, formerly green with cane-fields, being abandoned to the graziers, whose cattle, however, find a meagre pasture upon it for only a few seasons longer. There are no streams upon the island with the exception of a few rills, and the wells are failing. Cultivation is impossible without constant irrigation, and no means remain to sustain life. A planter not long since set out a few trees upon his estate, and lost every one. The island of St. Thomas is similarly affected, although, being loftier, it seems to have rather more rain. In the island of Porto Rico, which is almost wholly mountainous, the rain-fall still continues abundant, and the flora does not appear to have suffered. The sad change which has befallen the smaller islands is without any doubt to be ascribed to human agency alone—to the removal of the trees the present evil is attributed. The rainy seasons in these climates are not continuous cloudy days, but a succession of sudden showers, with the sun shining hot in the intervals; and the opening of the soil to the vertical heat of the sun causes its rapid drying,

and prevents the rain from sinking to the roots of the plants. An equally marked example of this result is seen in the small island of Curaçoa, which in 1845 was almost a perfect desert, while, according to history, it had once been a garden of fertility; the cause being the cutting down of the trees for the export of their valuable timber. Almost within sight of Curaçoa is the coast of the Spanish Main, covered with the rankest vegetation, over which the burdened clouds shower down abundant rain, while at Curaçoa fresh water is among the luxuries.—*Rep. Agricultural Department.*

ECONOMICAL USE OF FEATHERS.

M. De la Blanchère calls attention to the economical value of feathers, which are so generally considered as the refuse of the farm, especially those obtained in plucking ducks, chickens, and turkeys, and those of wild fowl and other birds killed as game. He remarks that by trimming these, particularly the larger ones, off the stump, which may be thrown away, the plumes will serve an excellent purpose; and they are now being worked up in Paris on a large scale in the manufacture of a feather cloth or blanket, which possesses the essential quality of being exceedingly light, while at the same time very warm. The plumes thus separated from the stalk are to be placed in a bag, closed tightly, and then subjected to rubbing between the hands, as in washing clothes. In a few minutes the fibres are separated from each other, and form a perfectly homogeneous and very light down. This can be sold, or worked up directly into coverlids, and other household objects, by quilting.

In Paris this down sells readily for $2 a pound, and the price is continually increasing. According to De la Blanchère, the feathers of an ordinary chicken will produce down worth at least 20 cents, a sum which it is of course very desirable to utilize. Of course something must be allowed for the time occupied in separating the plumes.—13 *B*, *January* 17, 1874, 88.

NEW POTATO DISEASE.

A form of the potato disease which has prevailed for several seasons in certain departments of France exhibits itself in a peculiar weakness of growth in the shoots, which attain

their usual length, but are wanting in thickness. The first leaves are also defective, but the tubers do not appear to be diseased nor affected in quality. A fungus is assigned as the cause, but further investigation is needed on this point.—8 *C*, *September* 25, 1873, 321.

INFECTION OF SOUND POTATOES BY DISEASED ONES.

Mr. Worthington Smith has lately presented the results of sundry experiments, made with a view to ascertain how far perfectly sound potatoes are likely to be contaminated by infected ones. For this object he secured, in the autumn of 1872, samples of different kinds of potatoes regarded as possessing certain disease-resisting qualities. From these he selected samples in different stages of disease previous to planting, and tested two supposed cures—namely, first, dusting the cut surfaces with sulphur; and, second, dipping the potatoes in a solution in water of pure carbolic acid and glycerine. Neither application, however, was found to be of any avail in preventing the disease.

In another series of experiments, diseased potatoes of one selected kind were planted with healthy ones of another. The result was that, although the selected kind resisted the disease better than the ordinary kind, yet in time they also yielded to it. In one case, however, a potato called the "Patterson's Victoria," claimed to be free from disease, was sliced and planted with diseased tubers, and, on digging, it was found that the latter were a putrid mass, while there was a good crop of perfectly healthy potatoes of Patterson's Victoria. Cut potatoes were found to take disease much more readily than those planted whole, and the fact was well established that certain varieties of potatoes, especially "Sutton's red-skin flour-ball," resisted the disease much better than others. But there is no evidence to prove that, for any one variety, absolute immunity from the danger of attack can be claimed.—2 *A*, *March* 7, 1874, 186.

IMPROVED MODE OF GROWING POTATOES.

Mr. Shirley Hibberd lately read a paper before the Society of Arts upon a new system of cultivating the potato, with a view to augment the production and prevent the disease. He takes the ground that the disease is rather an accompani-

ment than a cause; or, in other words, that it is due to certain climatic conditions, such as excessive moisture, and particular changes or stages of temperature, which, while weakening the plant, render it an easy prey to the fungus which is developed simultaneously. According to Mr. Hibberd, whenever there are sudden and positive alternations of unusual cold and great heat, accompanied by a copious rain-fall, the disease is always developed; and if, by any artificial means, it were possible to prevent these agencies from influencing the potato, we should measurably secure it from destruction.

The potato, more than any other plant under cultivation in Great Britain, according to Mr. Hibberd, is dependent for its health on continued solar heat; and if we can produce artificial sunshine above the surface of the ground, and artificial heat below, we shall save the crop at times when sunshine fails, and the ground is disastrously cooled by a heavy rainfall. This forms the suggestion of a method of treatment of the potato which, according to the author, has resulted in the most advantageous manner. It is well known that a favorable method of treating potatoes is to cultivate them in ridges, so that their roots may enjoy a maximum of ground heat, and be quickly drained of superfluous moisture by means of the trough between the ridges. If, now, every ridge were pierced with a tunnel, the advantage would be increased, since this would insure, beneath the plants, a body of imprisoned air, the non-conducting property of which would render it a storehouse of solar heat, maintaining the temperature of the soil nearly at the point it had attained before the weather changed, and, while favoring the rapid escape of surplus moisture, acting medicinally as well as nutritively to sustain the health of the plant.

Acting upon this suggestion, the author procured a quantity of common roofing tiles, laid them in lines in hard ground, and laid potato sets upon them, and then covered the whole with prepared soil, so as to form a long ridge, covering a shallow tunnel. The result was a remarkably heavy crop, the texture finer than the average, and without a trace of disease.

He then resolved to improve upon the plan by providing a better tunnel than was possible with the nearly flat roofing

tile, and one was adopted made expressly for the purpose, and known as the "Hibberd potato tile." This is a foot wide and fourteen inches long, being in the form of a low, flat-topped arch, four inches deep in the centre. These tiles are laid down in lines four feet apart, on hard ground, and as the sets are laid on the tiles they are covered with earth from the intervening spaces. The result is a series of rounded ridges, so far separated that the plants enjoy an abundance of light and air; lodgment of water is impossible, and in the event of a sudden lowering of temperature when the tubers are ripening, the storage of earth-heat below the roots tides the crop over the time of danger, and prevents that engorgement of the tissues which constitutes the first stage of the disease and the nursery for the fungus. The intervening spaces should be deeply dug and liberally manured, and planted, in the garden, with suitable crops, such as celery, dwarf pease, brocoli, etc., while in farm practice it may be best to leave the furrows open, because the sorts of potatoes selected would profitably utilize the light and air, and in strong land really meet across the furrows.

In response to the question whether the operation will pay in practice, Mr. Hibberd remarks that the outlay at first is considerable, and that the tiles, even in England, can not be obtained at less than $30 to $40 a thousand, or at the rate of about $350 per acre; or, if laid a yard apart, the cost would amount to $300 per acre.

Mr. Hibberd's experiments with these tiles have been conducted for nearly ten years, and he is emphatically of the opinion that, while in hot and dry seasons there is comparatively little advantage over the old method, yet in a majority of seasons, and always where these are unfavorable, the yield, in a very short time, is so much greater as to more than repay the cost of the tiles and furnish a handsome profit; and although he confesses he has occasionally taken diseased potatoes from the tiles, yet in several seasons he obtained a very satisfactory crop when others had none.

PRIZE FOR AN ESSAY ON THE POTATO DISEASE.

The Royal Agricultural Society of Great Britain, through the liberality of Earl Cathcart, was enabled to offer a prize of £100 for the best essay on the primary cause of the potato

disease and the best methods of its prevention. Ninety-four essays were sent in for competition, none of which, however, was considered as satisfying the conditions. Among the principal causes adduced by a large majority of the writers as bringing about the disease were: First, the degeneration of the tuber; second, fungus on the tuber; third, wet weather and generally superabundant moisture; fourth, *Peronospora infestans* attacking the foliage; fifth, electricity; and sixth, a plethoric or succulent or diseased condition of the plant caused by specific manures.

The remedies proposed were: Use of new sorts of potatoes for planting; steeping or kiln-drying the tubers previous to planting; use of lime as manure; clumping, tumping, or hillock-growing; bending the haulm downward clear of the tubers; tying the haulms upright, and other modifications of the mode of cultivation; dressing with sulphur, chlorine, etc.; cutting off tops on the appearance of the disease; sowing disease-proof sorts; the use of lightning-conductors of various modes of construction; and the avoidance of the use of certain manures.

In view of the unsatisfactory results of this competition, the committee have recommended that a sum of money, say £100, be granted for the purpose of inducing a competent mycologist to undertake the investigation of the life-history of the potato fungus (*Peronospora infestans*), especially in the interval between the injury to the potato plant and the reappearance of the fungus in the following year; and that a valuable purse be offered, first, for the best disease-proof early potato; and, second, the best disease-proof late potato; and also, for the purpose of encouraging the production of new varieties having the desired qualities, that prizes be offered for disease-proof potatoes of new varieties, to be sent in for competition in 1878.

In summing up the present state of our knowledge of this disease, the committee state that the natural history of the potato fungus, from the time it attacks the foliage until the potatoes are harvested, is now well known, but that we are entirely ignorant of what becomes of the parasite from the potato harvest until its reappearance the following year; therefore the latter portion of its history offers a suitable field for investigation.

The hope that varieties of potatoes may be found practically disease-proof is based upon the assumption that there is a definite period of incubation of this disease at certain seasons, and that certain varieties reaching maturity before this period, or after it has passed, may avoid its attack.

Professor De Bary, of Strasburg, has received the grant of £100, and entered upon the desired investigation.—18 *A, December* 26, 1873, 353.

ONE CAUSE OF THE POTATO DISEASE.

Among the numerous causes of the potato disease, according to Dr. Alfred Carpenter, a principal one consists in the accidental introduction of a diseased tuber into a pile destined for subsequent planting, the spores being transmitted from one to the other, so that the entire mass is more or less affected. Dr. Carpenter thinks that, as a general rule, the germs of disease must be pre-existing in the mother plant, but that they may remain entirely dormant or altogether inactive for a considerable period, or until favorable conditions of excessive moisture, heat, or other causes combine in proper ratio to quicken their growth. If measures can be taken to completely disinfect the seed-potato before planting, he thinks no apprehension need be felt as to the future.—*Jour. of Bath and West of Eng. Agric. Soc.*, 1873, 73.

THE HOOIBREUK SYSTEM OF FRUIT-CULTURE.

A year or two ago *Les Mondes* published an account of what was called the Hooibreuk process of fruit-culture, so named from its discoverer, an ignorant peasant on the Danube. This consists, essentially, in training the branches of fruit-trees, vines, etc., so as to give them an inclination below the horizontal line; in which case there is a great increase in the fertility of the branch, which, in fact, throws out leaves and fruit buds in an extraordinary manner. An essential condition of the process consists in having the line of the branch nearly straight; as, if curved, only the buds at the top of the arc are developed, while the rest remain in their original condition.

Duchesne-Thoureau, by whom the information was first communicated to *Les Mondes*, was of the opinion that the increased vigor of the branch thus treated was caused by its

being made to assume the condition of a siphon, the longer end downward, thus producing a much greater flow of sap. In one instance he took four vine plants, and trimmed them so as to have one stem to each, arranging these vertically, obliquely upward, horizontally, and obliquely downward. He then cut off the limbs alike, and found that from the limb inclined downward more than three times as much fruit was produced as from the others.

In a more recent communication to *Les Mondes*, Duchesne-Thoureau maintains the continued success of the process, and states that it has been introduced with great profit into many parts of France, and that all that is necessary to accomplish the result is to give to the branches the gentle declination already referred to; the only inconvenience likely to result from the extended application of the method being to make fruit too abundant, and thus measurably reduce the profits of the cultivators.

Duchesne-Thoureau advises that at least half the fruit buds developed in the branches in this way should be destroyed, so that the remainder may acquire a full development.—3 *B*, *September* 25, 1873, 108.

BARKING TREES, FOR TAN, WITH STEAM.

An apparatus, patented by Maitre, for the employment of steam in peeling bark for tan (described in *Dingler's Journal* for 1867), in regard to which very contradictory opinions were expressed, has been tested at Wiesbaden, under supervision of the government, with the following results: The quality of the leather corresponds to the amount of tannin in the bark. The variation of the amount of tannin in the bark at different seasons of the year is too small to be regarded in tanning. The amount of tannin in bark removed by the aid of steam in the spring from trees felled in winter showed no loss, either in chemical analysis or by actual experiments in tanning. The process, therefore, on these points, is not objectionable.—14 *C*, 1873, CCX., 394.

HOOIBREUK METHOD OF FERTILIZING PLANTS.

A process, invented by Hooibreuk, for facilitating the fertilization of plants has lately been successfully tried, according to *Les Mondes*, in the Botanical Gardens of Vienna. This

consists in simply touching the extremity of the stigma of the flower about to bloom with a brush dipped in honey, or, still better, in honey mixed with the pollen of the plant to be operated upon. This, in the case of *Hibiscus Mexicanus*, which had never borne fruit, resulted in the production of perfect seeds. The operation has succeeded very well with certain fruit-trees, some of which have thus been caused to produce fruit for the first time. As an explanation of this result, it is suggested that the honey keeps the grains of pollen upon the stigma, and thus favors the development of the pollen tube, which is indispensable to fertilization. The substitution of glycerine for honey in the experiment has been suggested.—3 *B*, *December* 25, 1873, 715.

CONTINUED GROWTH OF BARLEY ON THE SAME LAND.

As the result of experiments on the growth of barley on the same land for twenty years in succession, Messrs. Lawes & Gilbert report that when the same crop is grown consecutively on the same ground for a series of years, mineral manures, alone, fail to enable the plant to obtain sufficient nitrogen and carbon to yield even a fair crop; that nitrogenous manures, alone, increase it very considerably; but that the largest crops are obtained when nitrogen and mineral manures are applied together. In the case of barley, these combined manures gave for twenty years in succession, on the same land, rather more of both corn and straw than farmyard manure did, considerably more than the average barley crop of the country grown under a system of rotation of crops, and an average weight per bushel of between fifty-three and fifty-four pounds.—13 *A*, *February* 14, 1874, 179.

MANUFACTURE OF MAT-WORK FROM THE BARK OF THE LINDEN.

A great variety of articles, including grain-bags, wagon-covers, floor-covers, ropes, sails, etc., is made in Russia from the inner bark of the bass-wood or linden-tree; a million of trees being destroyed annually in the manufacture, and the value of the articles produced amounting to about $2,400,000. The bark is collected by the peasants in May and June, when the ascent of the sap renders peeling easy. That of the lower part of the trunk, generally employed for roofing, is ob-

tained in pieces about five and a quarter by three and a quarter feet, and is warmed and pressed to prevent its curling. That of the upper part of the trunk and of the branches is tied in bundles and rotted under water until September, when it is dried by aid of heat, and separated into thin, delicate strips, suitable for weaving into matting, and varying in weight according to the use to be made of it. The heaviest is sold at the Nishni Novgorod fair at about $24 per hundred-weight.—14 *C*, CCIX., 172.

A NEW FORAGE PLANT IN GUATEMALA.

A new forage plant has lately been sent to the Société d'Acclimatation of Paris, from Guatemala, by M. Rossingol, director of Public Gardens in Guatemala City—namely, the téosinte (*Reana luxurians*). This plant, M. Rossingol informs us, thrives best in the temperate and cooler part of Guatemala, on which account he thinks that, if protected against frost, it may be cultivated in almost any part of France. It is a very vigorous plant, having leaves resembling those of Indian corn, but of a darker green, and often much broader. These leaves are cut at stated intervals, and oxen fed with them fatten very rapidly. The young shoots furnish an excellent dish for the table. The plant is quite ornamental on account of its beautiful foliage, and is frequently cultivated in gardens in Guatemala.—10 *B*, *February*, 1874, 168.

PRESERVATION OF WOOD LANDS.

Professor F. B. Hough, who for many years has been meteorologist to the State of New York, has published a valuable paper on the duty of governments in aiding the preservation of wood lands. Professor Hough states that the extensive data at his command, although they reveal great irregularities in the rain or snow fall of any given locality, do not justify us in supposing that in the general average of periods the amount is sensibly increasing or diminishing, although they do show a tendency to drought in some cases for a series of years together. This growing tendency to floods and droughts he ascribes directly to the clearing up of wood lands, by which the rains quickly find their way to the streams, and swell them into destructive floods. The

various considerations presented by Professor Hough show how difficult a problem it is to increase the extent of the American forests, but he says he has confidence in the ability of the American people to work out a practical system adapted to our social organization and our general theory of law. We must begin at the centre of power, and make the people themselves familiar with the facts and the necessities of the case, and he considers that much may be done by withholding from sale valuable timber lands, by exempting from taxes the lands planted for timber, and, lastly, by requiring that the elements of science, so far as they apply to forestry, be taught in the public schools.—*Proceedings of the American Association*, 1873.

DESTRUCTION OF NIGHT-FLYING INSECTS.

Millions of insects injurious to trees may be destroyed by keeping up numbers of small fires, from twilight to midnight, and surrounding them with circles of from twenty to thirty tarred stakes, not more than six inches apart. Although few insects will be found burned to death, since they soon seem to acquire a dread of the fire, many will be caught in the tar while moving about in the warmed stratum of air, or to and fro from the fire.—10 *C*, *May* 1, 1874, 77.

PROPAGATION OF POTATOES BY CUTTINGS.

Potatoes of large size are said to be produced by a monk in France by cutting two side shoots from each stalk when it is five to seven inches high, and setting them in good, rich, mellow garden soil. In a few days they send out roots, and form tubers about as early and in as large quantities as the original stalk, while the latter does not seem to be injured by the moderate pruning. The experiment also seems to have been successfully tried elsewhere previously. The plan may be found especially serviceable in the propagation of new and rare varieties for seed.—9 *C*, *June*, 1874, 81.

POISONOUS SUPERPHOSPHATES.

The European agricultural journals have lately contained frequent accounts of the injurious working of ammoniated superphosphates. The opinion has been expressed that, under certain circumstances, especially in soils poor in lime, the

phosphoric acid may have a corrosive action upon the plants. It seems probable, however, that the trouble does not come from the phosphoric acid at all, but rather from the sulpho-cyanic acid in the sulphate of ammonia, which is often used in the preparation of the so-called "ammoniated superphosphates." The sulphate of ammonia, which is made as a by-product of the manufacture of coal-gas, and is largely used for this purpose, often contains sulpho-cyanide of ammonia. Investigations by a number of German experimenters indicate that this works as a violent poison for vegetation. It is well, therefore, to be sure that it is not present in ammonia salts used as fertilizers. It is easily detected by the red color which results from its solutions with those of salts of peroxide of iron.

KEEPING GRAPES FRESH.

A method of preserving grapes for a long time, even from one autumn until the next summer, has come into extensive use. The grapes are kept on the vine as long as possible—in France, where this device originated, to the end of October or beginning of November. Before the first frosts appear they are cut, leaving a portion of the stem, of about two or three knots below the bunch and two above it. The section of the upper end is then to be covered with wax, to prevent the evaporation of the liquids contained in the pores of the wood; and after carefully removing all the unsound grapes the lower end of the stem is inserted in a small elongated bottle filled with water, having a small quantity of wood charcoal in the bottom. The space between the stem and the tightly fitting cork through which it is inserted is to be filled with wax. The bottles thus fitted are to be placed on shelves in a dry room, and there arranged so as not to fall over, this being best prevented by inserting them in holes bored in a frame, as close together as they can stand conveniently.—1 *B*, *June* 13, 1874, 173.

EXPERIMENTS ON DIGESTIBILITY OF HAY BY SHEEP.

In the experiment station at Hohenheim, in Germany, under the direction of Dr. Von Wolff, a series of experiments has lately been performed to determine the influence which the addition of different kinds of beets and turnips to rations

of bean-hay and aftermath exercise upon the digestibility of the latter. The effect of easily digestible materials, as grain and root-fruits, upon the digestion of hay and straw by domestic animals has been made the subject of a large number of investigations in the German experiment stations. In the series here referred to sheep were the animals, and young succulent bean-hay, aftermath from a meadow, and beets or turnips, the fodder employed. The animals were fed for a certain period with the aftermath or bean-hay alone; during another period turnips were added. In each case the amounts of the different ingredients of the hay or aftermath digested by the animals were determined, and thus the effect of the turnips upon the digestion became known. It was found that when turnips were added in the proportion of 16 to 28 pounds to 100 pounds of dry substance in the bean-hay, 3½ to 5½ per cent. less organic substance of the hay was digested than when this was fed alone. An addition of a like proportion of turnips to the aftermath caused a decrease of 2½ to 5½ per cent. in the digestion of the dry substance of the latter. It must be borne in mind that bean-hay is very rich, and turnips are very poor in nitrogenous material, while the aftermath, like ordinary hay, holds a medium position in this respect. Since the nitrogenous material constitutes the most valuable part of the food, its digestibility in a ration is of very great importance. The decrease in digestion of nitrogenous material produced by the addition of turnips to the ration was less with the bean-hay than with the aftermath. These results accord with those of previous experiments performed at Hohenheim and elsewhere, in indicating that the digestibility of the nitrogenous material in fodder rich in nitrogen is less depressed than that of fodder poor in nitrogen by the addition of easily digestible substances poor in nitrogen.

Some other results of considerable interest were gained from the experiments of which we are speaking. It is an old observation that hay kept stored for a considerable time loses somewhat of its nutritive value. This may be attributed either to a loss of nitrogen or to a decrease in the digestibility of the ingredients of the hay. It may be added that in the handling, particularly of clover, there is apt to be a loss of the leaves and other more digestible portions of the

plant. The hay used for these experiments was kept stored during the winter, and was analyzed at the times of the experiments in November, February, and April.

In November the amount of nitrogenous material in the bean-hay was 24 per cent.; in April it had fallen to 23.3 per cent. During the same interval the nitrogenous material in the aftermath decreased from 14.6 per cent. to 13.9 per cent. There was likewise a decrease in the digestibility of the hay during this interval. In November 64.9 per cent. of the organic substance of the bean-hay was digested; in April only 62.3 per cent. With the aftermath the decrease in digestibility was greater, being in November 67.1 per cent., in April 72.7 per cent. The authors of the experiment consider it undecided whether this less digestion was due to a loss of easily digestible parts of the plant or to an actual decrease in the digestibility of the ingredients. The observations made in other experiments, particularly at Wunde, substantiated by these, show that the crude fibre of gramінaceous plants is considerably less digestible than that of leguminous plants.—28 *C*, 1874, 339.

PURE AND MIXED LINSEED CAKES.

The journal for 1873 of the Royal Agricultural Society of England contains a very valuable report by Professor Voelcker on "The Characters of Pure and Mixed Linseed Cakes." As chemist to the society, Dr. Voelcker often receives in a single year 150 or 200 samples of various kinds of feeding-cakes and meals for examination. Some of the results of this extensive experience are presented in the report referred to, which discusses the composition and characters of pure linseed cakes, and the means of distinguishing genuine from inferior or adulterated cakes; the materials used in the manufacture of mixed or compound feeding-cakes, and the properties of various substances employed for adulterating linseed cake; the composition and properties of inferior and adulterated mixed cakes; and the causes which render feeding-cakes either poisonous or more or less injurious and dangerous to the health of the stock. In order to find an explanation of the remarkable difference in the quality of linseed cakes, a large number of samples of commercial linseed from various parts of the world were examined, and foreign

weed seeds and impurities found therein, in amounts varying from 1½ to 70 per cent. Some twenty-three different kinds of seeds were found, besides various sorts of clover and grass seeds. Among these were seeds of rape, red or wild mustard, white mustard, dodder, purging-flax, corn-cockle, millet, sheep sorrel, dandelion, knot-grass, buckwheat, etc. Of these, rape-seed is itself quite valuable for cakes, and a number of the other seeds are of themselves harmless. Of the materials used in the manufacture of mixed or compound feeding-cakes, a list of more than thirty kinds is given, including rape cake, groundnut cake (peanut), cotton cake, palm-nut cake, castor-oil cake, curcas cake, olive cake, rice meal, bran, and sawdust. "Some of the materials which, like curcas beans or castor-oil cake, are downright poison, do not frequently occur, and generally get mixed with feeding-cakes through ignorance or carelessness; as when the sweepings of warehouses, granaries, or provision stores are pressed into compound cakes." Besides curcas and castor-oil beans, no other positively poisonous ingredients were found in linseed cakes. In rape-seed cake, however, black or wild mustard frequently occurs in such quantities as to render it entirely unfit for feeding purposes.

The injurious effects observed from the feeding of oil-cakes are often due, not to any poisonous adulteration, but rather to a mouldy, rancid, or heated condition of the cake. The evil effects of mould and rancidity are discussed at some length in Professor Voelcker's report. Instances are cited of death of animals from eating mouldy oats as well as mouldy feeding-cakes. A number of analyses are given of pure, adulterated, and poisonous feeding-cakes, which show that the mere chemical analysis of a cake does not necessarily throw much light upon it as a feeding-cake. A much surer method of detecting adulterations is found in microscopical examination. The differences in structure of the cuticle and other parts of the different kinds of seeds used in the manufacture of oil-cake are quite characteristic when examined by the microscope, as is illustrated by diagrams in the report. In general, Dr. Voelcker finds in these examinations great reason for carefulness in the purchase of oil-cake for stock. As regards the relative value of American and English linseed cake, Dr. Voelcker says that, "as a rule, the bulk of American

cake is better than the majority of linseed cakes that are manufactured in England and sold as genuine linseed cakes. Pure English linseed cake, as regards quality, however, can compete successfully with the best American barrel cake." The general superiority of American cakes he attributes to the practice of drying the cake, and sending it over to England in barrels instead of packing it in bags, whereby it is prevented from damage by heat in the passage.—*Jour. Roy. Agricult. Society*, 1873, 1.

MEAT-FLOUR AS FOOD FOR PIGS.

A comparatively new foddering material, known as meat-flour, is attracting considerable attention at present among German experimenters. This material is manufactured from the meat which remains from the preparation of "Liebig's Meat Extract." At Fray Bentos, in Uruguay, in South America, immense numbers of cattle are slaughtered annually for the preparation of this meat extract. The muscular tissue (the lean meat) is separated, cut in fine pieces, and treated for some time with water at 140° Fahr., which dissolves out a portion of the organic and mineral substances. The broth thus formed is boiled down until it is quite thick, and contains 20 per cent. water, forming the meat extract. Of late, attempts have been made to utilize the meat remaining from this treatment—over 90 per cent.—which was formerly wasted. It is dried and finely ground, and in this form contains some 73 per cent. albuminoids and 12½ per cent. fat. Since the nitrogenous ingredients of the food, the albuminoids, alone contribute to the formation of flesh and other nitrogenous parts of the animal body, and since these ingredients of the food are the most costly, it is evident that a material so rich in albuminoids as the meat-flour, if it could be successfully used as fodder, would be of great value for mixing with fodder materials poor in nitrogen. How important it might become as an article of commerce appears from the fact that the Fray Bentos Company alone slaughters annually some 78,000 cattle, which would furnish 6,000,000 pounds of the meat residue, containing 4,500,000 pounds albuminoids.

The value of this meat-flour as food for swine has been tested at several of the experiment stations, and by some practical farmers in Germany, and with results in the main quite

gratifying. It is found necessary to restore the alkaline salts removed in making the extract. In absence of these, the animals lose their appetite, become sickly, and in some cases show signs of *rachitis* and softening of the bones. When meat-flour, with chloride and phosphate of potash added, was mixed with potatoes and fed out to pigs, the animals fattened rapidly, and showed a normal and healthy growth. The nutritive value of meat-flour fed in this way has been tested by Lehmann, Dünkelberg, and Hoffmeister, at the experiment stations in Bonn, Munich, and Dresden, and with similar results. In each, the increase in live weight, after subtracting what was calculated to be due to the potatoes, was about one pound to one pound of meat-flour. Hoffmeister and Delius have, from the results of these experiments, made some calculations as to the nutritive value of animal, as compared with vegetable albuminoids. They infer that the albuminoids of meat-flour have nearly double the value, as expressed by the increase in live weight produced, of those of barley. Hoffmeister adds: "Meat-flour has thus proved in all respects excellent as a nitrogenous food to be added to other foods rich in starch for feeding young swine. It should, however, be fed in small quantities. By so doing, excellent results can be obtained."—22 *C*, 1874, 137.

J. PISCICULTURE AND THE FISHERIES.

OIL FROM SHARKS' LIVERS.

The preparation of oil from the livers of sharks, rays, saw-fish, etc., is conducted on a large scale on various portions of the sea-coast of India. For this purpose the fish are usually taken in October and November, the livers being then in their best condition. Although the quality does not vary with the season, the amount is about three times as great in autumn as in spring. The most esteemed livers are firm and rose-colored, while those which are whitish and flabby are rejected.

The first operation consists in removing the gall-bladders; the livers are next slashed in various places, and washed to remove the blood. They are then placed in a large earthen vessel, with enough water to cover them; are heated for fifteen or twenty minutes, and then allowed to cool. The oil which floats on the surface is gathered in ladles and poured into glazed earthen jars; it is next passed through a sieve, and all which does not pass through is thrown away. Three or four days later it is again filtered through a thick strainer to separate the deposit of stearine, this operation being repeated three or four times at intervals of twenty to twenty-five days. The oil then remains clear, of a fine straw color, smelling very much like cod-liver oil. An inferior quality of oil is made by simply heating the livers, without previously washing or picking them. The better quality of this oil is used for medical purposes. That of the shad is similarly used in China.—17 *A*, *March* 1, 1874, 40.

FISHERIES AND SEA TEMPERATURES.

The Scotch Meteorological Society instituted, nearly twenty years ago, a series of valuable observations on sea temperature, the observations being taken at the uniform depth of six feet, and special observations were made at greater depths, extending even to fifty feet, while a highly important series of hourly observations, continued during four years, were made at the depth of sixty feet. During the past year

Mr. Stevenson has had constructed, for the use of the *Challenger* exploring vessel, as also for the Scotch station, an apparatus for these observations, by which a maximum and a minimum thermometer are immersed continually under the water, thus insuring the securing of the absolute extremes of the temperature—extremes which would most likely be missed if observations were taken only at great intervals. The Marquis of Tweeddale, in 1872, proposed that the society should enter upon the investigation of the migrations of fishes, and particularly those of the herring, in connection with sea temperatures and weather generally, and stated that it was in his opinion likely that the herring followed belts of water of a higher temperature than that of the sea generally. The statistics of the herring catch during the last two years has been, in consequence, made the subject of two elaborate reports by Mr. Buchan, secretary of the society, and positive results of considerable value are anticipated. The subject has also actively engaged the attention of the United States Commissioner of Fish and Fisheries, at whose request the Army Signal-office, some two years ago, instituted a similar series of observations of sea temperature, and who has moreover suggested that it may, through the admirable organization of that office, soon become possible to predict from day to day the migrations of shoals of the more important classes of fishes.—12 *A*, IX., 346.

MARINE FISHERIES OF MAINE IN 1873.

According to the Gloucester *Telegraph*, the total value of the cured and packed herring, cod-fish, haddock, pollock, and mackerel in Maine last year will approximate $600,000, giving employment to not less than 550 men. In catching cod and mackerel 861 vessels are employed, aggregating 46,196 tons' burden.

CONSUMPTION OF MARINE PRODUCTS IN WASHINGTON.

Some idea of the extent to which the products of the sea enter into the food consumption of a city may be gathered from a recent report by Mr. C. Ludington, inspector of this class of articles of food for the city of Washington.

According to this account, during the year extending from October, 1872, to September 30, 1873, the number of fish sent

to the city markets amounted to 852,900 shad, 3,789,800 herring (or alewives), 326,200 Taylor herring, 553,761 bunches of small fish, 496 sturgeon, 448,557 bushels of oysters, 524,000 clams, and 336,000 crabs. The total number of all kinds of fish is estimated at 9,428,581, and as weighing 8,548,851 pounds.—*Report of C. Ludington.*

ACT IN REGARD TO KILLING SEALS IN ALASKA.

At present the principal source of income to the United States from its acquisition of Alaska, and that which pays the larger part of the interest on the original investment of $7,000,000 in its purchase, is derived from the fur-seal islands of St. Paul and St. George, which constitute the Pribylov group, situated in the Behring Sea, and north of the Aleutians. It is from these islands that the greater number of the skins of the fur seal, as known in commerce, are derived, the animals resorting to them in immense numbers every spring for the purpose of bringing forth their young.

Although a few seals are taken elsewhere in the North Pacific, the breeding-grounds or rookeries are almost entirely in the Pribylov group; and, as such, require to be guarded with great care, especially in the way of determining the class of animals that shall be killed, and of limiting the number.

In 1870 an act was passed by Congress placing this limitation at 100,000, of which 75,000 were to be taken from the island of St. Paul, and 25,000 from St. George, and it was made unlawful to kill any female seal, or any male less than a year old. The Secretary of the Treasury was also authorized to lease the islands for a term of twenty years, from the 1st of May, 1870, at an annual rental of not less than $50,000, and in addition a royalty of $2 per skin was to be exacted. The natives, however, were to be allowed to take a certain number of skins for their own purposes, upon which a similar royalty was to be paid. In fact, the total annual receipts from the islands, at the present time, amount to $271,000.

The Alaska Commercial Company secured the contract, and has carried it out in apparent good faith. The condition of the islanders has been considerably improved, and attention has been paid to their moral and physical welfare. The interests of the United States are guarded by a resident

Treasury agent (Captain Bryant), with an assistant on St. Paul Island, and another on St. George, who sees that the law of Congress and the regulations of the Treasury Department are complied with. Upon Captain Bryant's recommendation, Congress has lately directed that the proportion of animals to be killed on the respective islands be left to the discretion of the Secretary of the Treasury, provided that the maximum of 100,000 be not exceeded. It is found that not more than ten to fifteen thousand skins of the first quality can be obtained on St. George, while St. Paul will yield more than seventy-five thousand without any danger of affecting the general supply. Although the full number has hitherto been taken by the Alaska Company from St. George, yet more than half the skins were of inferior quality, and brought much less than the average price.

Congress has also authorized the appointment, by the Treasury Department, of a commission to proceed forthwith to the North Pacific and investigate the natural-history and geographical distribution of the fur seals. He is to be accompanied by an officer of the navy, whose more especial duty will be to look into the affairs of the Alaska Commercial Company. Mr. Henry W. Elliott has been selected as the Treasury agent, and Lieutenant Maynard by the Navy Department.

THE FRENCH FISHERIES.

In the *Revue Maritime et Coloniale* for March, 1874, we find a summary of the sea-fisheries of France for the year 1872. This has not been prepared with the same care as in previous years, and fails to give the tables of aggregates of the different fish taken at the several stations, as well as of the men and boats employed. All the figures, however, show a gratifying increase as compared with former statements: the total products amounting in value to more than 74,000,000 francs, being an increase of 4,000,000. As 1871 was the best year since 1817, when the statistics were first collected, the exhibit is very satisfactory to French political economists.

The yield for 1872 would have been still greater but for a decided decrease in the herring-fishery. This, according to the article referred to, was due to two causes: the first, that a large stock was carried over from the previous year in consequence of the competition produced by the large yield from

the coast of Scotland; the second, the unusual amount of stormy weather which prevailed from the beginning of October to the end of the year.

The French fisheries are divided primarily into two classes: those relating to the cod, conducted on the Banks of Newfoundland and about Iceland, and those prosecuted on the coast of France itself. The product of the Newfoundland fishery amounted to about 10,500,000 francs, with 187 vessels, being an increase of nearly 2,000,000 francs and of 24 vessels over the number in 1871. The Iceland fishery afforded about 6,400,000 francs, with 252 vessels, an increase of 819,000 francs and 26 vessels over the number in 1871. The greater number of boats for a much smaller yield in Iceland is due to their smaller size as compared with the Bankers.

The total increase in the value of the cod-fishery for the year amounted to about 2,819,000 francs. The shore fisheries proper yielded 24,204,000 francs, with a force of 63,066 men and 18,340 boats—a decided increase in all respects as compared with 1871. The oyster-fisheries yielded 417,000 francs more than the previous year, this being due to the greater development of the trade, and possibly to the success of artificial measures for their introduction, as also to the regulations to prevent waste and injury. The sardine-fisheries of 1872 were much more productive than those of 1871, the difference being nearly 2,000,000 francs.

It is very much to be desired that measures should be initiated in the United States for determining the value of our sea-fisheries with some of the precision practiced in France, whose system is perhaps more efficient than that of any other nation in Europe. The republic is divided into 22 districts, from each of which is a report of the number of men employed, the number of vessels, with their tonnage, the products, and the total yield—in each case a double column being exhibited of the fisheries for the year, and the difference, plus or minus, as compared with the year preceding. There is also a supplementary table, showing the line and seine fishing, without the use of boats, and other statistics.

One fact of much importance suggests itself in the examination of these tables—namely, the small extent to which the anadromous fish enter into the food supply of France. Thus we find mention of the capture of salmon only to the value

of 14,000 francs, of shad to the value of 9000 francs, and of smelts to that of 16,000. Although this is probably far from representing the total catch of these fish, it is the highest figure reported from all the districts into which the country is divided.

Among other points connected with the fisheries of France, we find one feature referred to in the statistics of these fisheries that might very properly be imitated in our own country—namely, the establishment of extensive reservoirs both for fish and crustaceans, in which the living fish are placed after capture, and kept for an indefinite period of time, or until wanted for the market. Of course, the floating boxes used in Boston and New York for keeping fish alive, in the vicinity of fish-markets, answer a certain purpose; but the French establishments are on a very large scale, and capable of keeping in excellent condition many hundreds of tons of fish each.—*Revue Maritime et Coloniale, March*, 1874, 818.

ALASKA COD-FISHERIES IN 1873.

According to the Alaska *Herald*, seven vessels were engaged throughout the summer of 1873 in the capture of codfish on the coast of Alaska, with a total yield of 583,000 fish, or an average of 83,285 per vessel.

THE SEAL AND HERRING FISHERIES OF NEWFOUNDLAND.

A valuable tract has lately been published by Michael Carroll, of Bonavista, Newfoundland, upon the seal and herring fisheries of that island, which contains what appears to be a very thorough and trustworthy account of the subject. In regard to the herring, this writer remarks that as soon as the ice moves off the shore in the different northern bays in the spring, herring strike in to spawn, and that they visit the same harbor, cove, or creek each season, and very nearly on the same day. If not prevented by ice, when the spawning time arrives the herring will swarm to the beach, always selecting a sandy one for such a purpose, and can be taken in any desired number with the simplest form of nets. The fish taken in the spring around the island are generally very poor and of uniform size. Those taken in gill nets are superior in quality to those caught in the seines, and will keep much longer without salt. This is due especially to the fact

that the coating of scales is unbroken in the one case, while with the seine these are generally scraped off. Fish taken from the seine, and salted after four hours, are often of little value; while those taken from nets will bear a delay of eight hours without injury. Exposure to the atmosphere is also said to be injurious, particularly with a southwest wind.

FISH-CULTURE IN THE CASTALIA SPRINGS.

It is a remarkable fact, and one having an important bearing upon fish-culture, that the Castalia Springs, in Erie County, Ohio, have been found to be admirably suited to the growth and culture of the trout and young salmon. These springs are of great size and uniform temperature, and flow throughout the year. At three to six feet below the surface the thermometer indicates 48°. What is peculiar in these waters is the immense amount of mineral substance they contain, a single gallon holding in solution ninety-four grains of solid matter and eighty-four cubic inches of carbonic acid gas. The bicarbonate of lime constitutes fifty-seven per cent. of the whole, the sulphates of lime and magnesia coming next. Bicarbonate of lithia is also found in considerable quantity. The water of these springs has never been used as a therapeutic agent, but there seems to be no reason why it should not be as serviceable as many others of much repute.—7 *D*, *November*, 1873, 169.

DECREASE OF LOBSTERS ON THE ATLANTIC COAST.

The subject of the decrease of lobsters on the North Atlantic coast has excited much apprehension of late, especially in view of the demand for this crustacean for canning. Concerted measures are now being taken by parties interested, both in the New England States and in the Provinces, to regulate the capture of lobsters by limiting the size of those that may be taken and disposed of; or by a prohibition of the capture of females for a part or the whole of the season; or by the establishment of a period of close time, during which none may be captured. A favorite restriction is that of weight, the limit of a pound and a half being proposed. As, however, the lobsters in some parts of the country scarcely reach that weight, even at an advanced age, proper care must be taken not to have too large a minimum.

So great has become the decrease of lobsters on the coast of Massachusetts and Maine that the canning establishments in those states find it almost impossible to obtain a supply, and they have been compelled to resort to the waters of the Dominion for this purpose. It has been estimated that during the year 1873 not less than 20,000 tons were captured in the Dominion waters, a large portion being exported to the United States.

It may not be known generally that on the 7th of July, 1873, an order was promulgated by the Governor-General providing that "in the Provinces of Quebec, Nova Scotia, and New Brunswick no person shall at any time fish for, catch, kill, buy, sell, or have in possession any soft-shell lobsters, or female lobsters with eggs attached; *nor shall lobsters of a less weight than one and a half pounds* be at any time fished for, caught, killed, bought, sold, or had in possession; but when caught by accident in nets or other fishing apparatus lawfully used for other fish, young lobsters of less weight than a pound and a half shall be liberated alive at the risk and cost of the owner of the net or apparatus, or by the occupier of the fishery, on whom in every case shall devolve the proof of such actual liberation."

INTRODUCTION OF BRITISH FISH INTO INDIA.

In 1868 carp, tench, trout, and other fish were carried from England to the cinchona plantations of the Neilgherry Hills, in Southern India; and we learn from *Ocean Highways* that while the trout have not succeeded very well, the growth and increase of the tench have been marvelous. The first fish were introduced into a lake at Utakamund by Lady Napier in August, 1869, and at the present time they are caught and sold in large numbers by the natives. Many of these fish have been taken below the great Kalhutty waterfall, showing that they have survived after being carried down the highest fall from the Neilgherries in the descent of the Utakamund River to the plain.—6 *A*, *January*, 1874, 431.

RESTOCKING OTSEGO LAKE WITH FISH.

For some time past efforts have been in progress, under the direction of Seth Green, of Rochester, for restoring to Otsego Lake, near Cooperstown, New York, the full supply of

so-called Otsego bass, formerly so plentiful, but which of late years have become very scarce. This delicious fish is not a bass, as its name would seem to indicate, but belongs to the whitefish family, and is scientifically known as *Coregonus otsego*, differing but slightly, however, in external form from the whitefish of the upper lakes.

In the autumn of 1871 a hatching-house was established, under the direction of Captain Cooper, in which 74,000 young bass were reared, and placed in the lake in March, 1872, together with a number of young salmon-trout from the upper lakes. In the winter of 1873 100,000 more young bass were planted, together with 20,000 salmon-trout, and a large number of bass taken during the present year are now in the hatching-house at Cooperstown. This large supply will doubtless soon manifest itself in the increased number of marketable fish; and if the effort be continued for a few years longer, there can be no question as to the ultimate restoration of the original abundance. Many hundreds of young bass and at least a thousand rock-bass have been placed in the lake, which will undoubtedly multiply in due proportion. The introduction of rock-bass will add a new element to the ichthyology of the Susquehanna River, to which this fish is not originally native.

CAUTION IN PLANTING YOUNG SALMON.

According to Riedel, care should be taken, in planting young salmon, not to introduce them into brooks already occupied by trout, as the latter show the greatest avidity in attacking the new-comers, and soon exterminate them.—*Circular D. Fischerei-Verein*, 1873, VII., 266.

TRANSPORTING LIVING TROUT.

An article in one of the circulars of the German Fishery Association, in reference to the transportation of living trout, recommends that, before the transfer is attempted, the fish be kept for eight or ten days where they can not have access to any food. The author remarks that when trout have been recently captured the water in which they are placed very soon becomes turbid, and unfit for their preservation, but that after a few days this tendency disappears. It is also considered objectionable to transport male with female fishes near

the spawning season, as the former are apt to discharge their milt, and thus affect the water.— *Circular D. Fischerei-Verein*, 1873, VII., 246.

STOCKING A POND IN UTAH WITH EELS.

A. P. Rockwood, a fish-culturist in Utah, placed five hundred silver eels, received from the East, in Zion's Co-operative Fish Pond, in Salt Lake County. This discharges into a tributary of the Jordan River, which connects Utah Lake with Great Salt Lake. The Utah papers announce the capture, on the 12th of August last, at the mouth of the Provo River, of an eel two feet in length, and weighing one pound seven ounces, which is supposed to be one of the stock referred to.

DESTRUCTION OF FISH ON THE OREGON COAST BY NITRO-GLYCERINE.

Mr. A. W. Chase communicates an interesting fact in connection with an account of the destruction of fish on the Oregon coast by means of the explosion of nitro-glycerine. In this he remarks that some of the fish are killed outright by this explosion, while others appear to be simply stunned, and that in several instances, after having fish, apparently dead for half an hour, scaled, the intestines taken out, and prepared for cooking (the head, however, remaining on the body), they began to flop around as briskly as if just taken from the water.

STERLET FROM ST. PETERSBURG AT THE BRIGHTON AQUARIUM.

An interesting occurrence to British fish-culturists took place in the arrival at the Brighton Aquarium, on the 16th of September, of nine living sterlets from St. Petersburg, brought by the British steamer *Dwina*. These were taken in the Volga River, and brought in the well of a boat fourteen hundred miles to St. Petersburg. The sterlet is a small species of sturgeon, very much prized in Russia, where it is considered superior even to the turbot. Its introduction into the waters of the United States has been proposed, and it is probable that the subject will receive due attention from the authorities.—2 *A*, *September* 26, 1874, 243.

K. DOMESTIC AND HOUSEHOLD ECONOMY.

MODIFICATION OF KLINKERFUES' GALVANIC GAS-LIGHTER.

The essential feature of this improvement by Baron Oldershausen, of Vienna, consists in the employment of a sudden increase of pressure — a gradual increase having no effect — and in the attachment of a second burner beneath the principal one, which is ignited by the heated platinum spiral, and is automatically extinguished after it has ignited the principal burner. Mercury and floats are employed for extinguishing the accessory and principal flames. Although ingenious and effective, the apparatus seems too complicated for general introduction for street lamps. —6 *C*, *December* 18, 1873, 506.

IMPROVED ELECTRIC ILLUMINATION.

The system of electrical illumination invented by the Russian Ladiguin is attracting much attention from technologists, as furnishing a very important improvement, both as to economy and brilliancy. In the old method the electric spark was passed between two pieces of burning charcoal, each joined to a copper wire connected with the electric machine, separate machines being necessary for each, and the light obtained, although powerful, being very difficult of regulation, and continually interrupted, in consequence of the rapid consumption of the charcoal points from exposure to the air.

In the new method only one piece of charcoal or other bad conductor is required, which, being attached to a wire connected with an electro-magnetic machine, is placed in a glass tube, from which the air is exhausted and replaced by a gas which, at a higher temperature, will not combine with the charcoal. This tube is then hermetically sealed, and the machine being set in motion by means of a small steam-engine, the charcoal becomes gradually and equally heated, and emits a soft, steady, and continuous light, which, by a most simple contrivance, can be strengthened or weakened at the option of those employing it, its duration being dependent solely

on the electric current, which, of course, will last as long as the machine is kept in motion.

By this invention of Ladiguin it is claimed that one machine, worked by a small three horse-power engine, is capable of lighting many hundreds of lanterns, thus exhibiting an enormous advantage and profit from its use. It promises to be especially valuable from the absence of any damage arising from explosion or the emission into the atmosphere of the products of combustion, or the accidental escape of gas. It is asserted that an equal amount of light for the purpose of house or street illumination can be obtained at one fifth the cost of gas.—22 *A*, 1873, 552.

GAS-BURNER WITH PLATINUM ATTACHMENT.

A large part of the illuminating power of gas is lost in using an ordinary burner, because the temperature of the interior of the flame is too low to effect the complete combustion of the carbon. It is claimed that this can be remedied, according to a recent Belgian patent, by introducing a strip of platinum between the openings of a common fish-tail burner, against which the gas plays, and which, when heated, causes the complete combustion of the gas, and at the same time diminishes its flow. Careful photometric experiments, it is said, fix the illuminating power at double that of the same amount of gas consumed with an ordinary burner. The accidental bending of the platinum is prevented by four copper wires attached to the burner.

A similar object is accomplished with the ordinary fish-tail burner by slipping or screwing a cap, with a slit in the top, over it. The gas is discharged into the very small cavity thus formed, and is ignited after passing through the slit.—13 *C*, *September* 15, 1873, 1161.

PURIFICATION OF EXPENDED LUBRICATING OIL.

To accomplish this, procure a tub of about sixteen gallons' capacity, supplied with one spigot at the bottom and one about four inches above, and, placing in it 6½ quarts of boiling water, introduce 2000 grains of chromate of potash, 1540 of soda, 1920 of chloridè of calcium, and 3840 of common salt. Then add fifty quarts of the oil to be purified, stir well for five to ten minutes, allow to remain perfectly quiet for a

week in a warm place, and then draw off the clear oil by the upper spigot.—9 *C*, *July*, 1873, 109.

BRILLIANCY OF GAS FROM DISTILLATION OF THE PINE.

According to Professor Benevides, of Lisbon, gas obtained by distillation from the pine-tree is much more luminous than that from coal, the difference, according to careful comparison, being as five to one. The density is about twice as great. It is rich in carbon, and requires special burners, with very small apertures, so as to burn without smoke or offensive smell, in this respect resembling petroleum.—18 *A*, *October* 6, 1873, 60.

EXTINCTION OF PETROLEUM FLAMES.

A writer in *Les Mondes* quotes from Ommeganck, of Antwerp, a very curious and perhaps valuable method of extinguishing the flames of burning petroleum—flames upon which water seems to be without effect. Chloroform, this writer asserts, is absolutely non-inflammable, and mixed with petroleum in the proportion of one sixth will render the latter also incombustible. More than this, if a liter of petroleum be poured into a shallow dish, so as to expose a surface of a hundred square centimeters, and then ignited, fifty cubic centimeters of chloroform cast upon the flames will extinguish them, and render the remainder incapable of reignition. In this case the quantity of petroleum would be nearly fifteen times that of the chloroform. If similar results can be obtained on a large scale, it would be obviously desirable for vessels laden with petroleum to carry also a supply of chloroform. To be sure, the expense of the latter substance might at first sight seem to be an obstacle, but it would certainly be much better to expend a reasonable sum in this way than to lose a vastly more valuable property in the flames.—3 *B*, *April* 30, 1874, 760.

SAFE AND CHEAP RED-FIRE.

The mixture for red-fire, generally composed of nitrate of strontia, chlorate of potash, and sulphur, frequently ignites spontaneously, especially when flowers of sulphur or imperfectly dried nitrate are employed. The following mixture, which can be prepared comparatively cheaply as well as

safely, is free from such a tendency, and burns with excellent effect, quietly, and comparatively slowly, and even when strewn upon the damp ground: one part, by weight, of shellac, and four of thoroughly dried nitrate of strontia are well mixed, in an unpulverized condition, in a tin dish, and heated to the melting-point of the shellac, and the semi-fused mass is pulverized after cooling.—5 *C*, 1874, XIII., 103.

MAINTENANCE OF A UNIFORM TEMPERATURE.

General Morin has proposed a method, both simple and inexpensive, of maintaining a temperature as constant as possible in a given locality through all the seasons of the year. The principle he announces is simply that of regularly renewing the air of any given place by causing cool air of a constant temperature to flow into it by the aid of a moderate aspiration. In order to obtain this cool air, he states that at a depth of about seventy feet in the earth the temperature is constant, and that it is to this fact that is due the uniform temperature of several French public halls alluded to by him, which are supplied with air drawn through subterranean galleries. He gives, also, an elaborate calculation of the quantity of air, at a given temperature, necessary to be introduced into any apartment in order to keep it in a uniform condition (somewhat cooler than the average summer temperature), and shows that to maintain such a temperature it is not necessary to have recourse to the employment of deep caves, expensive to construct and to keep free from watery infiltrations; but that, on the contrary, by a proper arrangement of rooms one can establish the reservoir of cold either at the level of the soil or at a moderate depth beneath it, giving it plenty of fresh air and sunlight, and in which a temperature a little lower than that of spring-time can be maintained without inconvenience.—6 *B*, *November*, 1873, 743.

WOODEN SOLES FOR SHOES.

Wooden shoe-soles are manufactured by Böhme, of Schandau, by means of a machine specially devised for the purpose. These internally have the shape of the foot, and when attached to leather uppers form shoes not only as elegant in appearance, but as comfortable, it is said, as those with

leather soles, from which, indeed, they can not be distinguished, although costing only half as much. Worn-out soles can be replaced at a trifling cost, the same uppers outlasting two or three soles. Red or white beach wood is mainly used in their manufacture.—34 *C*, XVIII., 164.

WASHING COTTON GOODS WITHOUT INJURING THE COLOR.

Add to rain-water so hot that the hand can not be held in it an amount of wheat bran equal in weight to one eighth of the fabric to be cleansed, and after stirring well for five minutes add the goods; stir them about with a clean stick, and bring the whole to a boil. Allow this to cool until the articles can be washed out as usual, after which rinse them well, and dry. They will be as pure as if soap had been used, and it is said that the colors will be uninjured.—26 *C*, 1874, I., 4.

REMOVAL OF RUST STAINS FROM FABRICS.

To accomplish this object, so desirable in domestic economy, moisten the spot with a solution of Epsom salt in a few drops of hot water, and after a few minutes rub it in well and moisten again. Next fill a tin vessel with boiling water and set it on the stained space for a few minutes, and afterward wash out in soft water. If the spot be old and not easily removed, the operation must be repeated. It is advisable to have articles thus treated washed at once.—25 *C*, 1873, 214.

PREVENTING BENZINE STAINS ON CLOTHING.

The brown marginal stain generally left after the use of benzine or naphtha for removing grease from clothing may be prevented by strewing gypsum or lycopodium upon the cloth immediately after the removal of the grease-spot, as far as the material is moist, allowing it to dry, and then simply brushing off the powder.—9 *C*, *July*, 1873, 109.

DRY CLEANING WITH TURPENTINE AND ITS PURIFICATION.

Articles to be cleaned, except those of silk, velvet, plush, etc., are rubbed on a sharp, tinned washboard five to eight minutes in turpentine of the finest quality, in a tin-lined wooden vessel, and after being placed in a centrifugal machine, and then hung up for two hours in a drying-room at

133°, they will be odorless and clean. For silk, velvet, plush, etc., Venetian turpentine is applied by gently rubbing spots of paint, tar, etc., with a good sponge or woolen rag. Turpentine that has become turbid by use may be purified by stirring it well with $\frac{1}{160}$ of its volume of oil of vitriol, and allowing it to settle overnight, and then, as a precautionary measure, filtering it through a felt bag. A beautiful bluish tint can be imparted to pure white goods by tinting the benzine employed, by adding to it some benzine which has been colored by steeping in it a piece of cotton colored with aniline blue.—26 *C*, 1874, VI., 52.

DRY OR CHEMICAL CLEANING WITH BENZINE.

Scouring with benzine has proved to be, undoubtedly, one of the very best methods, since the end is perfectly accomplished without shrinkage or injurious effect upon the color or finish, so that the most elegant garments need not be taken apart, nor lace nor velvet trimmings be taken off; while with men's clothing it is not noticeable that they have been washed. The articles, freed from dust and dirt by beating them while dry, are first simply thoroughly moistened with benzine in a tinned-copper or stone-ware vessel, and well squeezed in it with the hands, silk pieces, ribbons, and heavier portions that may require it, being brushed well on a zinc-covered table supplied with a tube beneath for re-collecting the benzine. The deepest stains are marked and treated more thoroughly. The articles are similarly treated in a second bath of benzine, and then carefully dried in a centrifugal machine for ten to fifteen minutes, the benzine being re-collected in a vessel beneath. On removal from it they are smoothed out and hung in a warm drying-room, with access of air. It will require ten to twelve hours, after they are dry, to remove the odor completely. Since benzine acts principally upon fatty matter, stains of street mud, etc., may remain, and must be removed by gently rubbing with a soft sponge dipped in cold water to which a little alcohol has been added, and then drying with a soft silk cloth. Sugar, champagne, and egg stains are also removed with cold water, and the color is brought up again with a little acetic acid and alcohol in water, the spots being well rubbed out. Blood spots are treated similarly. In all these cases the

formation of marginal stains around the spots must be prevented by thorough use of the soft sponge and soft silk cloth. An article that still retains decided stains is brushed with a cold decoction of soap-bark, to which some alcohol has been added, and is then quickly passed through water, and then through water slightly acidulated with acetic acid, and dried rapidly. Kid gloves are well rubbed with the hands, separately, in benzine, each finger being then rubbed on a stretcher with a rag, and after being blown up they are hung up to dry. Articles treated with benzine need but little subsequent finishing, and this may be accomplished by applying a solution of gum arabic in water, and a little alcohol, uniformly, with a rag, and ironing. Portions of coats that have been taken apart need simply be stretched and moistened uniformly with alcohol, and allowed to dry rapidly. Heavy cloth, velvet, etc., after being well steamed, are treated on the wrong side with so little dressing (best of tragacanth) that it does not go through, and are then placed on the finishing frame or warm drum. White furs and angora tassels are passed immediately from the benzine through pulverized chalk, and allowed to dry, and are then beaten out, when the leather will remain elastic and the fur look well. Benzine that has become turbid by use may be purified by thoroughly stirring ten drops of oil of vitriol into about two bucketfuls of it, and allowing it to settle. The operations must of course not be conducted near the lamp or fire, on account of the combustibility of benzine.—26 *C*, 1874, VI., 52.

CEMENT FOR RENDERING CORKS TIGHT.

The corks should be brushed several times with a mixture of a solution of shellac, of the consistency of sirup, prepared by the aid of heat, and with a similar solution of caoutchouc in benzine, separately prepared; care being taken that one coat is perfectly dry before another is laid on.—5 *C*, 1874, XIX., 152.

REMOVING GREASE-SPOTS WITH BENZINE.

The usual method of moistening the spot with benzine or turpentine, and rubbing with a rag, often until the nap is completely removed, produces at best a very transitory effect, the spot reappearing, if any thing, larger and more un-

sightly after dust settles upon it. The only proper way to completely remove the grease is to lay the soiled part of the garment upon several folds of white blotting-paper, moisten it thoroughly with benzine or turpentine, place several folds of blotting-paper upon it, and press with a cold iron. The operation should not be conducted near a naked flame, since benzine is very volatile and combustible.—9 *C*, *July*, 1873, 109.

BLEACHING SHELLAC BY BONE-BLACK AND SUNLIGHT.

Shellac bleached by the ordinary process affords a polish for light woods, etc., that is brittle and liable to peel off, while the presence of a trace of chlorine causes metallic inlaying to become dim. These defects may be avoided by a different mode of bleaching—namely, by adding fine granulated bone-black to the solution of shellac in ninety per cent. alcohol until a thin, pasty mass is formed, and exposing this for several days to direct sunlight, occasionally shaking it thoroughly, and filtering when sufficiently bleached.—5 *C*, 1873, xxxvi., 288.

NEW ITALIAN METHOD FOR PRESERVING GRAPES.

It is said that grape clusters can be preserved until Easter, as fresh and palatable as when cut, by gathering them in small quantities, on clear, dry days, removing any decayed berries, fuming them with benzine, and laying them (not in contact, however) between fine corn-leaves, in drawers or trays carefully closed against the air and dust.—9 *C*, *July*, 1873, 105.

NEW METHOD FOR PRESERVING MEAT.

According to Endemann, meat cut in slices and placed in a room the air of which is heated to 140°, and only allowed to enter and escape through cotton filters, becomes so dry in three hours that it can be ground, and, since the albumen and fibrine are not coagulated, it loses none of its nutritive properties.—5 *C*, 1873, xxxix., 312.

WINDHAUSEN REFRIGERATING MACHINES.

It is stated that in New Orleans several refrigerating machines of the Windhausen pattern, which operate by expanding compressed air, have been constructed that are compe-

tent to expand and deliver continuously 150,000 cubic feet of air per hour, at a temperature of from 30° to 35° below zero, Fahr. If the actual work accord with these representations, it seems probable that machines upon this principle, being free from the drawbacks and difficulties attendant upon the use of chemical substances in refrigeration, must in time supplant them.

DETECTION OF CHICORY IN A DECOCTION OF COFFEE.

It was stated at a meeting of the Berlin Polytechnic Society, in reply to an inquiry for a trustworthy test for chicory in boiled coffee, that a decoction of the coloring matter of chicory root is not precipitated by sesqui-salts of iron, but retains its color, while the brown coloring matter of coffee is changed by a solution of sesqui-sulphate of iron to a light green, and is partially precipitated in bluish-green flakes. In a mixed decoction of both, after addition of a few drops of the iron salt the liquid above the precipitate retains a brownish-yellow color, according to the amount of chicory present. The separation of the precipitate may be hastened by rendering the colored liquid slightly alkaline with ammonia.—15 *C*, 1873, xxiv., 383.

MUTTON WINE OF THE CHINESE.

Among the peculiar preparations of the Mongolians and Chinese are certain animalized liquids, which consist of the flesh of different kinds of animals, such as sheep, dogs, deer, snakes, etc., macerated in distilled liquors, with various other ingredients, as sugar, honey, raisins, milk, etc., and then subjected to boiling under considerable pressure. The liquid thus prepared has a very strong odor of the animal substances used, and is sweetish to the taste, and very much in vogue as a medicine for curing various diseases.—*Journal North China Branch Roy. Asiatic Soc.*, 1873, VII., 237.

WINE MADE WITH YEAST.

According to Erckmann, yeast wine is prepared as follows: 26½ gallons of thick yeast are stirred with 53 gallons of water, a solution of 165 pounds of potato sugar and 4.4 pounds of tartaric acid in 79.2 gallons of water, having a temperature of 100° to 130°, is added, and the whole is fer-

mented at 66° to 77°, as a rule about two to three weeks, and then decanted into fresh casks, and half a gallon of 90 per cent. alcohol, free from fusel-oil, and 3½ ounces of tannin are added to each 26½ gallons. After standing four weeks it becomes clear, and is decanted into fresh sulphurized casks, and, if necessary, clarified in the usual way with isinglass. The color may be deepened by sugar-color, and the quality improved by the addition of glycerine, and still more by addition of raisins; the latter, freed from stems, being crushed, boiled a quarter of an hour, and added to the fermenting wine. The acidity of the product should reach 0.5 per cent., to which it may be brought, if necessary, by the addition of tartaric acid.—28 *C*, *May*, 1874, 395.

BRANDY FROM SAWDUST.

Zetterlund, after boiling 9 cwt. of sawdust with 7 cwt. of hydrochloric acid, sp. gr. 1.18, and 30.7 cwt. of water, under pressure of less than 2 pounds to the inch, found 3.33 per cent. of the mass to be grape sugar; and with 2½ hours of further boiling, 4.38 per cent., or 19.67 per cent. of the sawdust, to be grape sugar—an amount he was unable to exceed. After neutralizing the acid with lime until the cooled mash contained but ½ per cent., according to Lüdersdorff's test, at 86° a ferment made of 20 pounds of bruised malt was added. In 96 hours fermentation was complete, and distillation afforded 61 quarts of brandy of 50 per cent., at 59°, perfectly free from odor or taste of turpentine, and of very agreeable flavor. He considers it probable that the process might be successful on a large scale if the amount of water and time of boiling (two important factors in the production of sugar) were accurately determined by experiments. By conversion of all the cellulose into sugar, each hundred-weight of air-dried sawdust would yield at least 27.4 quarts of 50 per cent. brandy.—18 *C*, *June* 8, 1874, 399.

PASTEUR PROCESS FOR MAKING UNALTERABLE BEER.

Pasteur, the eminent French chemist, has recently given a method for preparing an unalterable beer; that is, a beer which will not turn sour or spoil upon keeping. It is important to consider two facts as preliminary to this process. In the first place, says Pasteur, all the objectionable changes

which beer or must undergo are due to the action of minute microscopic organisms, vibriones, bacteria, etc., whose germs are carried in the air, are contained in the materials used, or are found adhering to the utensils employed in the brewery. In the second place, under all the methods of brewing commonly employed, every must, every yeast, and every beer contain these germs. Without their presence beer can only undergo alcoholic fermentation, and possibly some minor changes which may in certain cases improve its quality, and in other cases produce nothing worse than vapidity. The thing to be done, therefore, is to prepare a must free from objectionable germs, and to ferment it by means of a yeast similarly pure. Pasteur proceeds as follows:

The must, prepared by the ordinary methods, is heated very hot in order to destroy all germs contained in it. It is then inclosed in a vat provided with a tight cover, whose interior communicates with the outer air only through two vertical tubes. At one of these tubes a current of carbonic-acid gas is allowed to enter, its excess being discharged by the other. In this vat, thus sheltered from all germs which might otherwise get in from the air, the must is allowed to cool. The next step is to add the yeast; and the main difficulty is to obtain this pure. This is done in a way which Pasteur does not describe in detail, but which depends upon the fact that the yeast plant multiplies more rapidly in the presence of atmospheric oxygen than in carbonic acid, while almost the contrary is true of the objectionable germs. A little of this pure yeast once obtained, it can be preserved indefinitely, and permitted to multiply in apparatus so constructed as to shelter it from the germs floating in the air. The yeast, free from these germs, being added, without contact of the air, to the must likewise free from germs, alcoholic fermentation sets in. A beer is thus obtained which, when finished, no longer offers a favorable medium for the development of the above-mentioned microscopic organisms. It can be preserved, as is usual, in barrels or bottles, and for an indefinite time, even without the use of ice. Even high temperatures do not affect it unfavorably. It undergoes only those changes which are commonly produced by age, and which are positive improvements rather than the reverse. The employment of ice-houses is thus avoided, the

expense of the ice saved, and a beer of superior quality produced.—6 *B*, *November* 17, 1873, 1140.

DETECTION OF PICRIC ACID IN BEER.

The method for detecting picric acid in beer, suggested by Pohl, according to Brunner, will indicate the presence of one sixty-fifth of a grain of the acid in a pint of beer, if conducted as follows: Immerse a piece of white woolen yarn in the beer, acidified with hydrochloric acid, on a water-bath. Since extractive matter will be precipitated by picric acid, and will impart a dirty, brownish-yellow coloration to the yarn, treat the latter with warm dilute ammonia water, which will extract all the picric acid; filter, and concentrate the solution on a water-bath to a small volume, and add a few drops of cyanide of potassium. The smallest trace of picric acid will be indicated by a red coloration, due to the formation of isopurpurate of potassium.—5 *C*, 1873, XLV., 360.

DETECTION OF FOREIGN BITTER PRINCIPLES IN BEER.

The following method for the detection of alkaloids and other poisonous substances and bitter principles in beer, employed by Dragendorff, is also followed by Kubicki, on account of its simplicity and inexpensiveness. The liquid to be investigated was evaporated on a water-bath to the consistency of sirup, 3 to 4 times its volume of 85 per cent. alcohol was then added, and the whole allowed to remain, without heating, for 24 hours, in order that the gum, dextrine, albumen, etc., might separate. It was then filtered, and the alcohol was completely distilled off. The residual liquid was allowed to rest, after cooling, for 10 to 20 hours, for the separation of any residue of the above substances, and then filtered. The filtrate was acidified with dilute sulphuric acid, and shaken for half an hour with about $\frac{1}{4}$ to $\frac{1}{2}$ its volume of petroleum naphtha, then poured into a burette having a glass stop-cock; and after complete separation of the liquids, by standing, the aqueous portion was drawn off for further treatment, and the petroleum carefully washed with distilled water to free it from any adhering portions of the aqueous liquid, then filtered, and the filtrate evaporated without the aid of heat. The object of this was to prevent the loss of certain volatile substances, and, if possible, to obtain the peculiar

odor of others, although the latter is but imperfectly accomplished, on account of empyreumatic matter present in the beer. The residual aqueous liquid was afterward treated with benzine and chloroform in the same manner as with the petroleum, and subsequently rendered alkaline with ammonia, and repeatedly extracted with petroleum, benzine, and chloroform. The final results, together with some of those of Dragendorff, are given in full in the annexed table.

A. *Shaken with an acid solution.*

I. Residuum from evaporation of the petroleum naphtha extract:

1. Crystalline, yellowish, difficultly volatilizable. The solution in sulphuric acid remains yellow; cyanide of potassium and hydrate of potash color it blood-red on warming. It colors cotton yellow. *Picric acid.*

2. Amorphous, white, of pungent taste, and reddening the skin. *Capsicine.*

II. Residuum from evaporation of the benzine extract:

1. Crystalline. (*a*) Not bitter; colored purple by caustic potash. *Aloetine.*

(*b*) Bitter; colored yellow by caustic potash; after warming, brown. *Daphnine.*

2. Amorphous. (*a*) Colored reddish-brown by sulphuric acid; precipitated by tannin. *Quassine.*

(*b*) Gives the odor of Menyanthis oil when heated with dilute sulphuric acid, while the liquid becomes turbid, and oily globules separate. *Menyanthine.*

(*c*) Colored blood-red, afterward brownish-red, by sulphuric acid. Hydrochloric acid affords a greenish solution; after warming, brown and turbid, with the separation of oily globules. *Cnicine.*

(*d*) Brown solution with sulphuric acid, subsequently violet. Similar reactions with Fröhde's reagent. *Absinthine.*

(*e*) Deep-red solution with sulphuric acid; a beautiful cherry-red with Fröhde's reagent; precipitated yellowish-white by tannic acid. *Colocynthine.*

(*f*) Colored brown by sulphuric acid; greenish solution with hydrochloric acid; becoming brown and turbid on warming. *Erythrocentaurine.* (?)

(*g*) Colored pure brown by sulphuric acid; by caustic pot-

ash, yellow; on warming, brown. Not precipitated by tannin. Colored red by nitric acid of 1.42. sp. gr. *Gentianine.* (?)

(Besides, possibly, a residue of Capsicine.)

III. Residuum from evaporation of the chloroform extract:

1. Crystalline. (*a*) Without alkaloid reaction. Gives a beautiful yellow solution with sulphuric acid. Mixed with nitrate of potash, then moistened with sulphuric acid, and finally treated with a concentrated solution of caustic soda, becomes brick-red. *Picrotoxine.*

(*b*) With alkaloid reaction. *Opium alkaloids.*

2. Amorphous. Residues unextracted by petroleum manifesting the same reactions as in II., viz., of Aloetine and Daphnine; also of Quassine and Cnicine, and the greater part of Menyanthine, insoluble in ether; and of Absinthine and Colocynthine, and the greater part of Erythrocentaurine, soluble in ether.

B. *Shaken with an ammoniacal solution.*

I. Residuum from evaporation of the benzine extract:

Crystalline. 1. Dilates the pupil. (*a*) Its aqueous solution is not precipitated by bichloride of platinum. Its solution in sulphuric acid emits a peculiar odor when heated. *Atropine.*

(*b*) Precipitated by bichloride of platinum, if exactly the proper quantity of the reagent is employed. *Hyoscyamine.*

2. Does not dilate the pupil. The sulphuric-acid solution becomes blue with ceric oxide. *Strychnine.*

II. Residuum from evaporation of the chloroform extract:

1. Sulphuric acid produces a colorless solution in the cold. (*a*) The solution is also but slightly colored by heating, and after cooling is rendered violet by nitric acid. Sesqui-chloride of iron renders the substance blue, and Fröhde's reagent affords immediately a violet solution of it. *Morphine.*

(*b*) The solution becomes violet on warming. *Papaverine.*

2. Sulphuric acid produces a grayish-brown solution, which becomes blood-red on boiling. *Narceine.*

III. Residuum from evaporation of the amylalcohol extract: Sulphuric acid forms a pure red solution at once. Warming with sulphuric acid and bichromate of potash develops the odor of salicylous acid. *Salicine.*

Unless the presence of salicine is suspected, this extract

should not be made. Although it might be possible, as the table suggests, to extract all the bitter principles by repeated shaking with benzine, so that the chloroform extract would manifest no reaction, this course would only be of practical value when very small quantities of the substances are involved; and since several of them can be much more readily separated in the chloroform extract, on account of the action of ether on that residuum, the repeated shaking with benzine should only be employed when there is reason to suspect, from the preliminary investigation, the presence of a small quantity of a particular adulteration.—18 *C*, *Dec.* 31, 1873, 826.

USE OF SULPHITE OF SODA IN DISTILLERIES.

It is stated, as the result of numerous experiments, that the employment of sulphite of soda, or, better still, the bisulphite, in steeping grain in distilleries, increases the product as much as the aqueous solution of sulphurous acid, without, at the same time, imparting the unpleasant flavor which so materially affects the price.—18 *C*, *December* 31, 1873, 831.

MODE OF TESTING BUTTER FOR ADULTERATION.

The method adopted by Hoorn for testing butter for adulterations differs somewhat from that of Dr. Brown. He employs a glass tube about eight inches long, and eight tenths of an inch in diameter for two thirds of its length, narrower and divided into tenths of a cubic centimeter for the other third, and closed at the narrow end. Into the tube are introduced 150 grains of butter, melted by means of warm water; 30 cubic centimeters of light petroleum-oil are added, and the tube is shaken vigorously and set aside. In thirty to forty minutes the petroleum becomes perfectly clear, and contains all the fatty matters in solution. The other constituents of the butter collect in the narrow part of the tube, and their volume may easily be read off. For more exact determinations the fatty layer is poured off, and the residue again treated with a fresh portion of petroleum; the whole being allowed to stand for two to three hours. Good butter contains from 10 to 14 per cent., adulterated butter as much as 40 per cent. of impurities, generally water. After separating the petroleum, the undissolved portion may be tested for flour, potato-starch, etc. The fatty solution is tested by evap-

orating the petroleum completely, dissolving 15 grains of the residue in seven cubic centimeters of petroleum-spirit in a well-closed flask, and placing the solution in water at 50° to 60° Fahr. for some hours. Fats of low melting-point being more soluble than those of higher melting-point, the butter fat remains in solution, while suet, tallow, and even lard, are deposited, if present to the extent of more than 10 per cent. —21 *A*, *October*, 1873, 1064.

EFFECT OF SALTING BUTTER.

The well-known fact that in the whole of Northern Europe all butter, without exception, is salted immediately on its production, while in the Southern countries none but the most inferior butter is either sold or used salted, led to the investigation of the effect of the salt by Martini. This included analyses of salted and unsalted butter by Professor Müller, and the conclusion was reached that the use of salt is advantageous to both the consumer and producer. The weight of the butter does not seem to be increased by the salt, since the weight of the liquid worked out about equals that of the salt added. The butter so treated is also found to be but little, if any, richer in fat, but to keep better and longer, not only on account of the antiseptic property of the salt, but because it is also partially freed from caseine and milk-sugar, the two ingredients which, in the presence of water, impart the tendency to decomposition. The salt also renders the working of the butter easier, apparently by partially reducing the adhesion between the caseine and milk-sugar and fatty particles, thus facilitating the removal of the former, just as salt added to pure milk will cause it to filter more rapidly, while caseine and milk-sugar pass into the filtrate, some caseine remaining with the fat on the filter. The preference for unsalted butter in some countries Martini attributes entirely to unfounded prejudice.—13 *C*, *November* 1, 1873, 1373.

IMPROVED MODE OF CONDENSING MILK.

A simple and cheap method of condensing milk, devised by Gfal, of Innsbruck, consists in heating the milk in a boiler to from 150° to 160°, and then pumping it up through pipes, at the mouth of each of which is a perforated rose, like that of

a watering-can. The milk thus returns in separate threads to the boiler, and in its passage the watery part is evaporated. This method is said to give concentrated milk quite as good as that by the ordinary processes, and with much less trouble and expense.—18 *A*, *November* 21, 1873, 237.

PREPARATION OF CAVIARE IN RUSSIA.

All of our readers have heard of caviare as a delicacy of Russian origin, only to be enjoyed by the rich; but many of them may not be aware that it is simply the roe of one or more species of sturgeon (sometimes indeed of other fish) prepared in a particular manner. All the rivers and lakes of America abound with sturgeon, consisting of several different species, some of them of enormous dimensions; and although in some sections these are marketed and consumed in considerable numbers, by far the greater proportion of those captured are either returned to the water or wasted, no special efforts being made to make use of them. Quite recently, however, some firms on Lake Erie have undertaken the utilization of the sturgeon, receiving immense numbers from various places on the lakes. They smoke the flesh, which is cut up into strips, and prepare the roe.

There are many peculiarities connected with the treatment of the sturgeon roes, and their conversion into caviare; and it may be of some service to those interested in the trade to know how this is prepared in the White Sea and the Caspian, the head-quarters of the business. According to Mr. Alexander Schultz, two kinds are made: one fresh or grained, and the other the hard or pressed. In both cases, the roes are placed upon a web or net-work, with narrow meshes, forming a kind of sieve, stretched over a wooden hoop. (Possibly a fine wire gauze would answer a still better purpose.) The fish eggs are then forced through the meshes by pressing the whole mass lightly, until nothing is left on the upper surface but the cellular tissue, the fat, and tendons. The eggs fall into a wooden receptacle placed beneath, and are next sprinkled with very fine salt of the best quality, the mass being stirred with a large wooden fork having eight or ten teeth. The quantity of salt necessarily varies, according to the season, from 5 to $1\frac{3}{4}$; that is to say, in the month of August, three to five pounds of salt are used to the poud (36 pounds)

of roes, and $1\frac{3}{4}$ to $2\frac{1}{2}$ in the winter. The less the caviare is salted, the more it is esteemed.

At first the eggs, mixed with salt, exhibit a pasty appearance when stirred; but after each grain is thoroughly impregnated with the salt, the mass swells, and when stirred there is a slight rustling, similar to what would be the case in the stirring of fine particles of glass. This is a sign that the preparation is complete. The caviare is then placed in casks of linden wood, which imparts no unpleasant taste, as might be the case with most other materials.

To prepare the pressed caviare, a tub half filled with pickle, more or less strong with salt, according to the temperature of the season, is placed under the net-work. To secure a thorough impregnation of the eggs by the pickle, the mass is stirred with a wooden fork, turning it always from the same side. Then the eggs are strained out, and when thoroughly drained a quantity of about 100 pounds is placed in a sack, and subjected to the action of a press, in order to remove all the pickle, and convert the whole into a compact mass, as curd is converted into cheese. In thus preparing the caviare a number of the eggs are broken, and a portion of the contents runs off with the pickle, so that for each pond there is a loss of ten to twelve pounds. After removing the pressed caviare from the box, it is placed in casks, holding about thirty pounds, the interior of which is lined with napkin cloth, on which account, in commerce, this always bears the name of "napkin caviare." The better quality of the pressed caviare —that is to say, that which has been less mashed and salted— is placed in narrow, cylindrical cloth bags, and it is then called bag caviare. Caviare is also transported in boxes of tin, hermetically sealed. Fresh caviare is always preferred to the pressed, but is more expensive. Thus, at Astrachan, fresh caviare is worth from 30 to 35 rubles (the value of the ruble is about 78 cents) the pond, while the pressed is worth only 24. It is much more profitable to prepare the green caviare than the pressed, as it brings a better price, takes less salt, and requires less labor. There are exported every year from Astrachan about 11,000 ponds of caviare, which goes especially to Berlin, Dresden, and Vienna.

In commerce, the caviare from the roe of the Belouga sturgeon (*Acipenser huso*) is more esteemed than that from the

A. stellatus. The best of all is that of the sterlet (*A. ruthenus*); but this scarcely enters into commerce. The different kinds of sturgeon have roes differing in size, this depending upon the quality of the fish, the season, and the particular place of capture. The roes of sturgeon which are taken in the sea, between the 8th of July and the 15th of August, are allowed to remain only a few hours in the pickle, and they are then removed, and placed, without being pressed, in casks of five to ten pouds. If, on touching the roes, they are found to be tender, and the ovaries have already begun to decay, the roe, ovaries, and all are thrown into the pickle, so that the whole may be impregnated with salt. This is the most inferior quality, and is shipped in casks of twenty-seven pouds each, and is worth only three or four rubles per poud. This is known as summer caviare. The total amount of caviare obtained in the Caspian Sea fisheries amounts in one year to 139,000 pouds (about 5,020,000 pounds), worth 1,390,000 rubles, or $1,103,000.—*Report of Alexander Schultz, Vienna Exposition*, 1873, 44.

SPINAL COLUMN OF THE STURGEON AS AN ARTICLE OF FOOD.

Among the preparations of the sturgeon, which is utilized to so great an extent on the shores of the Caspian Sea, is one called *veziga*, which consists simply of the dorsal cord dried. As soon as the fish is disemboweled and the roe and air-bladder are removed, a cut is made along the back, the finger inserted, and the whole gelatinous vertebral column taken out. This is washed carefully in water, and compressed so as to bring out all the soft matter it contains; after which it is dried from three to eight days, according to the temperature. It is then made up into packets, of which 750 form a poud (36 pounds). When boiled, this substance swells, and is then cut up very fine and used as a composition for excellent fish-balls. It sells for $11 to $15 per poud.—*Fisheries of the Arctic Seas, Schultz*, 1873, 67.

USE OF HORSE-FLESH IN FRANCE.

The committee for introducing the use of horse-flesh into France reports that, during the first six months of 1867, 893 horses, asses, and mules were sold in Paris, the weight of which amounted to 166,000 kilogrammes. During the first

six months of 1870, the number of animals amounted to 1992, or 360,000 kilogrammes; while in the same period of 1873, 5618 animals were exposed in the markets, the flesh alone weighing 883,840 kilogrammes, not counting the heart, brain, liver, tongue, etc., which were also used like those of beef cattle. A similar extension of the use of horse-flesh was manifested in the provinces. The usual price paid by the butchers for these horses amounts to $25 to $30 each, the animals being killed only after their period of utility has passed, and when they are worth little or nothing. Allowing $20 as the increased sum realized from each animal in consequence of their conversion into food, we have the food resources of Paris alone increased by the amount of $103,720. A similar estimate, based upon the entire number of horses sold as food in the whole of France, indicates that the food resources of the country during 1873 will have been increased to the amount of $800,000; while the saving to the public by the difference between the cost of horse-flesh and the more expensive kinds is of course much greater.—11 *B*, *October* 15, 1873, 559.

MEAT BISCUIT.

A new form of biscuit for troops was used in the Russian campaign against Khiva, with very satisfactory results. This was composed of one third rye flour, one third beef reduced to powder, and one third of pulverized sauerkraut. Great relish for the food and the excellent health of those who used it were characteristic of the Russian soldiers throughout the campaign.—18 *A*, *January* 24, 1874, 454.

FRESHNESS OF EGGS.

An egg is generally called fresh when it has been laid only one or two days in summer, and two to six days in winter. The shell being porous, the water in the interior evaporates, and leaves a cavity of greater or less extent. The yolk of the egg sinks, too, as may be easily appreciated by holding it toward a candle or the sun, and when shaken a slight shock is appreciable if the egg is not fresh. To determine the precise age of eggs, dissolve about four ounces of common salt in a quart of pure water, and then immerse the egg. If it is one day old, it will descend to the bottom of the vessel; but

if three days, it floats in the liquid; and if more than five, it comes to the surface, and projects above in proportion to its increased age.—11 *B*, *October* 15, 1873, 559.

COCKROACH AND CRICKET EXTERMINATOR.

An approved remedy for the undue presence of these insects is prepared by mixing two parts, by weight, of fine flour with four of white sugar, one part of powdered borax, and one of unslacked lime, thoroughly stirring the whole together. Keep the powder in a perfectly dry place. For use strew some of the powder on paper placed in the infested place (taking care that no liquids remain uncovered), and repeat this process several nights in succession.—9 *C*, *July*, 1873, 101.

PREVENTING FLIES FROM ANNOYING HORSES.

According to Rochard, a French veterinary surgeon, a simple method of preventing flies from annoying horses consists in painting the inside of the ears, or any other part especially troubled, with a few drops of empyreumatic oil of juniper. It is said that the odor of this substance is unendurable to flies, and that they will be kept at a distance from the parts so anointed. If this treatment should accomplish the alleged result, it may perhaps be equally applicable in repelling mosquitoes from the faces and hands of tourists and sportsmen, when passing through woods or meadows.—20 *A*, *October* 18, 1873, 442.

ASPHYXIATING BURGLARS.

The manufacturers of vaults and safes for the preservation of valuables, and also those whose profession it is to enter them for the purpose of plunder, continue to develop a vast amount of ingenuity. Almost as soon as we have the triumphant announcement of absolute security as the result of some combination or construction, we find that the device has been successfully evaded. All the arrangements of chilled iron and other modes of protection seem to be of no value against the efforts of experienced "cracksmen," and attention now appears to be directed toward the addition of defensive weapons that shall maim or otherwise injure the intruder. One of the most recent devices of this kind consists in what

is called the Chemical Armor for Bank Vaults, which is so adjusted that, should the interior of the safe be penetrated by violence, sundry glass vials filled with sulphuric acid are necessarily broken, and their contents discharged into powdered carbonate of lime, resulting in the instantaneous production of enough carbonic-acid gas to asphyxiate a regiment. What mode of defense will be adopted by the opposite side, should this device be carried out to any extent, remains to be seen.

NEW METHOD OF SLAUGHTERING ANIMALS.

Killing animals by the so-called *boutrole*, first used in Paris, and recently introduced into Vienna, seems preferable to the old method, since an animal can be instantly killed by a single blow with an instrument weighing scarcely five pounds, instead of the ten to fifteen blows with the heavy hammer usually employed. The instrument is simply a very convenient form of axe, with a hollow cylinder (like a gun-wad punch) about six inches long and one inch in diameter, with its edge ground sharp, on the end opposite the blade. A single blow with this end cuts a round hole in the forehead, and produces instant death.—9 *C*, *November*, 1873, 163.

CLEANSING SPONGES.

According to J. Stinde, sponges that have become soiled, hard, and discolored by photographic use, may be again rendered perfectly pure and elastic by immersion in a wine-colored solution of permanganate of potash, and then in dilute hydrochloric acid (one part of acid to ten of water), and afterward washed thoroughly with water. Sufficient time should be given to the different parts of the operation.—5 *C*, 1873, XLII., 336.

PLASTIC CARBON FOR FILTERS.

According to Professor Kletzinsky, two mixtures have been found best adapted to this purpose in practice: the one consisting of 60 parts of coke, 20 of animal carbon, 10 of charcoal, and 10 of pipe-clay; the other of 10 parts of coke, 30 of animal carbon, 20 of charcoal, and 40 of short-fibred asbestos. The ingredients, except the asbestos, are finely powdered, passed through a sieve, and intimately mixed while

dry, and then mixed with as much molasses or sirup as may be necessary to form a plastic mass, about as much as the weight of the dry powder. This dough is well worked, and then formed into cylinders or disks, allowed to dry for some time at a moderate temperature, and then burned in a carefully heated muffle, without access of air. After being slowly cooled, the soluble salts are extracted, and the sulphide of iron decomposed, by placing the article in very dilute hydrochloric acid. The filter is then thoroughly washed in running water, dried, and again heated to dull redness in a well-closed muffle, and finally shaped, by turning, as may be desired, for beakers, funnels, etc. Closed hollow vessels can be formed by luting together two suitably shaped vessels of the substance by means of a certain paste. This is prepared by covering the turnings from the washed masses, thinly, with pure sirup (made by dissolving refined sugar in half its weight of water), and triturating them. The edges of the vessels to be luted are first well fitted together, and then coated with the paste, so as also to fill all the seams; and the whole, after drying thoroughly, is to be burned at a dull-red heat. While the fused sugar-carbon affords a vitreous mass, the asbestos and coke and coal give firmness and form the framework. The charcoal removes especially fusel-oil and odorous gases, and the nitrogenous animal carbon extractive and coloring matter. Tubes of different materials can be firmly cemented to the filters by plastic sulphur or good cement, such as is made with chalk, clay, and water-glass.—14 *C*, 1873, CCIX., 396.

GLYCERINE FOR PRESERVING LEATHER FROM AMMONIACAL VAPORS.

The addition of a small quantity of glycerine to the grease used for leather articles, exposed to the ammoniacal exhalations of horse stables, is said to have the desirable effect of keeping them soft and pliable.

INFUSORIAL EARTH AS A NON-CONDUCTOR OF HEAT.

Tripolite or infusorial earth, being a worse conductor of heat than coal-ashes, and almost as poor as flax-chaff, and being refractory, is adapted for walls of ice-cellars and fire-proof safes, for casing steam boilers and pipes, etc., and possesses the advantage of affording protection against rats and

mice. Its lightness is also a great recommendation. One cubic foot of it weighs 21½ to 26 pounds; the same bulk of dry coal-ashes, 40½ to 42½ pounds; and of dry earth, 94 to 128 pounds. For casing steam-pipes it is mixed with boiled flaxseed.—13 *C, June* 1, 1873, 108.

PROCESS FOR BENDING GLASS TUBES.

The *Polytechnisches Notizblatt* calls attention to the fact that a perfectly round bend of any curvature may be given to glass tubes if they are filled with fine dry sand and closed at both ends when heated for bending, as by a Bunsen burner. A similar plan is available with copper and lead tubes. —15 *C*, XVIII., 286.

POWDERED GUM ARABIC.

According to Dr. Hagar, gum arabic, under prolonged drying, preliminary to pulverization, not only experiences a loss of natural moisture (as high as ten per cent.), but also a slight change of properties, as indicated by its power of reducing, at a gentle heat, potassic solution of copper. After a time it also loses its ready solubility in water, and consequently oily emulsions are not as easily made with it. Hagar therefore advises that gum arabic be kept only as a moderately fine powder, and that in moist or cold weather it be dried no longer than one day in a warm place (about 80°), in which case it will lose but two per cent., or at most two and a half per cent. of its weight.—*Rep. of Alexander Schultz, Vienna Ex.*, 1873, 40.

KEEPING FLOWERS FRESH.

According to a communication addressed to the Agricultural Society of Paris, cut flowers may be kept fresh, for from fifteen days to a month, by inserting their stems in water in which sal ammoniac or ammonia chloride has been dissolved in the proportion of seventy-five grains to the quart.—3 *B, December* 25, 1873, 715.

RETAINING THE NATURAL COLORS OF DRIED FLOWERS.

Puscher recommends sticking the stems in the neck of a glass funnel, leaving the flowers in the wide portion, but leaving about an inch from the top unfilled. The funnel is

then to be inverted over a few drops of aqua ammonia on a plate. In a few minutes most blue, violet, and crimson flowers change to beautiful green, dark crimson to black or dark violet, and white to yellowish. If they are then immediately placed in fresh water, they will retain their new color from two to six hours, according to the amount of ammonia taken up, but will gradually regain their original tints. The customary way of treating blue, violet, and red asters for winter bouquets with nitric acid gives irregular results, on account of the wax on the leaves, and it is preferable to expose them to the fumes of hydrochloric acid, by hanging them, tied in pairs by their stems, heads downward on strings drawn across the interior of a close wooden box, upon the bottom of which are several plates with hydrochloric acid, and with two glass windows, on opposite sides, through which the progress of the coloration may be noticed, so that the flowers may be removed as they acquire the desired tints, and hung in the same manner in airy, shady rooms to dry. They should be preserved in a dry, dark place.—5 *C*, 1873, xxx., 238.

REGENERATION OF OIL-PAINTINGS.

Besides the irremediable darkening of oil-paintings by age, they are also liable to deterioration by the cracking of the paint on severe drying, and also to the loss of brilliancy by the formation of numberless small fissures in the originally transparent, heavy film of varnish upon them. The former defect can only be removed by the tedious filling of the cracks with fresh paint. As a means for remedying the latter, Dr. Weigelt suggests, as an improvement on a plan proposed by Pettenkofer, that the varnish be partially dissolved (and the fissures thus filled up) by leading upon the picture, through a gum tube, a blast of air which is saturated with alcohol, by blowing it, by means of a bellows, through a flask containing alcohol gently warmed.—15 *C*, IX., 129.

FIG COFFEE.

A coffee substitute, of roasted figs, has been in the market in Austria for ten years, and is also prepared at present in Berlin. Recent careful tests of it indicate that it possesses a more agreeable flavor than the chiccory substitute, and that it has thus far been brought into the market free from inju-

rious adulterations, often present in chiccory coffee. Samples from Berlin, in the form of a coarse, brown powder, including yellowish particles, formed an adhering, slightly gummy mass on being lightly pressed between the fingers, and possessed a sweetish-bitter taste like caramel, and a corresponding odor. Austrian samples, although in the main similar to the preceding, were slightly more pulverulent, and of a sourish taste, which fact, together with the chemical analysis, rendered it probable that cheaper, inferior, perhaps even spoiled figs, had been used in its preparation. At its first introduction wonderful medicinal properties were claimed for it in Austria, especially in affections of the lungs, etc., and it was recommended for nervous persons. Although it may be serviceable in such cases, it can hardly be considered medicinal, and the Berlin manufacturer claims that it is more wholesome than pure coffee simply because it is less stimulating. In all cases it is recommended to employ an equal quantity of coffee with the substitute; and the color as well as the flavor of the product is said to be exceedingly fine. —15 *C*, IX., 141.

CLEANING MOSS-COVERED STATUARY IN GARDENS, ETC.

It is recommended to first kill the vegetation by the application of petroleum and benzine, which will not injure the stone, and to remove it, when dried, by brushing, and finally rubbing with a rag.—10 *C*, *May* 1, 1874, 80.

SIZE OF WAGON-WHEELS.

Experiments recently made in England indicate that wagons are most easily drawn, on all kinds of roads, when the fore and hind wheels are of the same size, and when the pole lies lower than the axle.—10 *C*, *June* 1, 1874, 94.

CLEANING GILT ARTICLES.

Gilt metallic articles may be cleaned by rubbing them very gently with a soft sponge or brush dipped in a solution of one half an ounce of potash, or one ounce of soda, or, still better, of one half an ounce of borax in a pound of water, then rinsing them in pure water and drying with a soft linen rag. Their lustre may be improved, in special cases, by warming them slightly, and then rubbing them very gently.

Gilt frames, etc., should only be washed with pure water, rubbing very gently with a soft sponge or brush.—5 *C*, 1874, XXIII., 184.

JAPANESE MODE OF PRESERVING MEAT IN SUMMER.

The meat is covered completely, in a porcelain bowl, with very hot water, and oil is then poured upon the water. The air is thus excluded, and the coagulation of the albumen in the external part of the meat doubtless aids in preserving it. —9 *C, June*, 1874, 90.

DANGER OF CLEANING BOTTLES WITH SHOT.

A communication to the Paris Academy condemns the use of shot in cleaning bottles, as practiced in many households, on the ground that carbonate of lead may be formed in shaking them with water, and that some shot, with their not inconsiderable amount of arsenic, may possibly remain in the bottle.—10 *C, May*, 1874, 80.

AUTOMATIC GAS-LIGHTER AND EXTINGUISHER.

Instead of electricity for lighting gas, Baumeister employs a small accessory flame, which burns all day, with a consumption of 0.04 cubic feet per hour, or even less, although, when less than 0.03 cubic feet, the flame is liable to be extinguished by draft. By regulation of the pressure this flame is made to flare up and ignite the principal jet, and it then goes out; and again by a change of pressure the principal flame is extinguished, and the small one relighted, and the flow of gas to the principal burner again completely checked. There is also an attachment, which, under the average pressure, allows only a definite flow of gas through the burner, and which, it is suggested, can also be arranged as a simple and convenient pressure regulator.—18 *C, May* 13, 1874, 304.

IMPROVED GAS FURNACE.

An improved gas-burning apparatus, for heating purposes, was exhibited at the recent international exposition in London. It is, in reality, an improved form of Bunsen burner, and consists, in principle, of a brass tube, throwing a jet of gas into a hemispherical chamber into which air, as well as the gas, is driven by the expedient of having an opening, or

break of continuity in the gas tube, sheathed only by a covering of permeable, safety-lamp wire-gauze, just before it enters the hemispherical chamber. The gas leaps across the open chasm, dragging with it a current of air through the wire-gauze sheath. The air and gas mix in the chamber, and then rise through a transverse internal diaphragm of wire-gauze, to issue from a burner at the top. The flame produced by this arrangement is an emerald, amber-tipped cone, of very remarkable heating power, readily melting brass, silver, gold, and copper, and attaining a temperature of 3000° Fahr. The burner is made with 1, 4, 12, 16, or 24 flames, according to the use to which it is to be applied.—21 *A*, *Aug.* 15, 1873, 751.

NEW SAFETY LOCK.

Prokop, of Gratz, has constructed a lock on a new principle, which he claims renders it proof against picking, or copying of the key. The peculiarity, as gathered from a condensed description, consists in a keyhole curved upward instead of straight, with a corresponding compound curved key.—13 *C*, *June* 1, 1873, 719.

APPARATUS FOR MOISTENING LABELS, STAMPS, THE FINGERS, ETC.

A simple apparatus for moistening stamps, labels, the fingers, etc., in banks and counting-rooms has been devised, which obviates the necessity for frequent cleansing of a sponge, as when moist sponge in a porcelain dish is simply used. It consists of a porcelain dish with a double bottom, and the two separated by a small space, the upper bottom being filled with small holes, and having a hollow cylinder, serving as a reservoir, closed at the top, resting upon it, and in communication with the inclosed space. The apparatus is filled by immersing it entirely in a vessel of water, and then placing it in its proper position. The water oozes up through the perforations as needed, too rapid escape being prevented by the atmospheric pressure.—34 *C*, 1873, XII., 116.

WETTING COAL A MISTAKE.

It has frequently been maintained that wetting coal increases the amount of heat given out in combustion; but a

careful inquiry has shown, first, that there is no increase of heat; second, that a loss of heat always follows addition of water; third, that both the amount of heat and the temperature of the fire are considerably diminished.—21 *A*, *April*, 1874, 397.

TESTING MILK.

As a result of investigations, Professor Sacc proposes, as a test for the dilution of milk, mixing it with its volume of alcohol of 70° Tr., when, with pure milk, the coagulum formed will equal the milk in volume, and will invariably rise to the top.—14 *C*, CCXI., 247.

GUMMED ADHESIVE PAPER.

Paper recently introduced into the market in sheets, half of which are gummed on both sides, and the other half on one side, and divided into strips and squares of different sizes by perforations, like sheets of postage-stamps, promises to be very convenient in many ways—the doubly gummed answering for fixing drawings in books, labels on glass, etc. It is stated that the mixture by which it is coated is prepared by dissolving six parts of glue (previously soaked for a day in cold water), two parts of sugar, and three parts of gum arabic, in twenty-four parts of water, by the aid of heat. —15 *C*, 1874, VI., 95.

PROTECTION OF MAPS, PICTURES, ETC., BY AN INSOLUBLE COATING.

Coat a plate of glass thinly and uniformly with a warm mixture of one quarter of an ounce of ox-gall and one quart of a solution of glue, which will form a stiff jelly on cooling. When the film is well set, render it insoluble by immersion for two or three hours in a solution of acetate of alumina, which may be formed by dissolving one ounce each of alum and of acetate of lead in a pint of water, and decanting the clear liquid from the sulphate of lead formed. Then wash and rinse well, and give it an additional thin coating with weaker glue solution, and lay the picture, slightly but uniformly moistened, upon it, face downward; smooth out by gentle rubbing, place in a warm room three to four days, and remove from the glass, when thoroughly dry, by cutting the

film around it. The back of the picture may be coated in a similar manner, and it will then lie flat without a frame. The film may also be colored before applying the picture, by immersion in a bath of cochineal, logwood, etc.—13 *C, March* 1, 1874, 330.

PRODUCTION OF ICE IN MILD WINTERS.

It is suggested that by filling suitably constructed sheet-iron vessels to the depth of about an inch with water it will soon freeze, even when the temperature is but little below the freezing-point, and that by repeating the addition of water as the first portions become frozen, blocks of the clearest ice, six inches thick, may be formed during a night; and when the temperature by day is suitable, a single laborer will be able to fill a large ice-house in a short time. By pouring water, which has been cooled in the vessels nearly to the freezing-point, over the ice after it has been packed, at suitable intervals, when the temperature of the air is below the freezing-point, a compact mass of ice may be formed, of more value for use than a much larger quantity loosely packed. Even in winters favorable to the production of ice the above method may be found the most convenient, and the cheapest, for filling ice-houses.—13 *C, May* 1, 1874, 599.

WHEEL WITH INDIA-RUBBER TIRE.

Messrs. Bird & Co., of London, have lately brought into notice a new and improved wheel, with India-rubber tire, which is claimed to be capable of wearing as long as, or longer than, an iron tire, and to have the great advantage of perfect noiselessness and absence of injurious jar. The draught of the carriage is said to be reduced nearly one third by the use of this tire. It appears to be simply a tire of solid rubber, fastened on the exterior of an ordinary wheel by bolts, such as are used with iron ties; and it may be thinner than the usual kind, merely serving the purpose of a band to hold the wood-work firmly together.—2 *A, August* 29, 1874, 174.

L. MECHANICS AND ENGINEERING.

GERHARD PROCESS FOR OBTAINING PUDDLED IRON DIRECT FROM THE ORE.

Mr. F. W. Gerhard, of Staffordshire, has lately introduced a new process by which puddled iron is obtained direct from the ore, the blast-furnace being dispensed with. Instead of using pig-iron, Mr. Gerhard employs a compound of ore or any substance containing iron, the necessary fluxes, and the equivalent of carbon. A lump of this compound is put into the furnace, and by the single process known to the puddlers as "balling," a "heat" may be obtained in much less time and with considerable less labor than under the old method; the process of "melting" and "boiling" being entirely dispensed with. The special feature of the invention is the great saving of fuel, it being estimated that three thousand seven hundred and sixty pounds of coal are saved in manufacturing two thousand four hundred pounds of iron. In the opinion of some iron-workers, this method of making wrought iron must very soon supersede the present laborious and costly mode of manufacturing it from pig-iron.—3 *A*, *December* 27, 1873, 807.

IRON COLUMNS FILLED WITH CONCRETE.

The Westphalian Union, of Hamm, exhibited at Vienna several hollow iron cylinders filled internally with a stony mass, for which greater strength is claimed than that of unfilled columns with walls of the same thickness, and which may find extensive use for telegraph poles and building purposes. They are made by rolling a pile of puddled bars, filled with a peculiar sandy mixture, at a heat at which the sandy mass will fuse and unite with the iron walls.—13 *C*, *November* 1, 1873, 1365.

BESSEMER STEEL ESTABLISHMENTS IN THE UNITED STATES.

Mr. Alex. L. Holley, whose name is intimately identified with the growth of the Bessemer Works of this country, announces the following facts in connection with the working

condition of our Bessemer Steel establishments. The product of American Bessemer Works has been steadily increasing from various causes—better organization, better refractory materials, and chiefly numerous large and small improvements in mechanical details. In 1868 an output of 500 tons of ingots per month was barely reached in the best works; in 1870 the production at Troy and Harrisburg had risen to about 1700 tons per month, maximum. Early in 1872 the Harrisburg Works turned out above 2000 tons per month, and for a year or more these and the Cambria Works took the lead in this direction, the latter plant having run as high as 640 tons in one week. During 1873 the Cambria, Harrisburg, North Chicago, and Joliet Works averaged 25 to 30 heats of five tons each per 24 hours. During the week ending July 12, 1873, the Harrisburg Works made 180 heats, yielding 890 tons of ingots. The product of the Cambria Works for the week ending January 17, 1874, was 189 heats, giving 956 tons of ingots. During 24 hours (Friday, January 16) 46 blows were made. On Friday, February 13, 1874, the Troy Works made 50 heats in 24 hours, yielding 267 tons of ingots. This is the most remarkable run on record. During the week ending April 4 the Troy Works made 195 heats, yielding 972 tons of ingots, which is the largest week's work. In January, 1874, the Troy Works made 2899 tons of ingots; and in April the North Chicago Works made 3526 tons, which is the largest month's work. These are all five-ton plants, consisting of two five-ton vessels and accessories, and they work only eleven turns, or five and a half days per week.

FIRE-PROOF JOISTS.

A practically fire-proof joist, invented by Mr. Walker, promises to be an important addition to the means of erecting approximately fire-proof edifices. This consists of a slip of wood five inches wide by five eighths of an inch thick, bolted between two flanged strips of quarter-inch iron, making a beam quite as strong as those of wood ordinarily employed. The iron sides, in addition to affording strength, it is claimed, render the joist substantially fire-proof, while the centre of wood affords the means of putting down floors and nailing on laths in the usual manner. The impediment to the manufacture of these joists heretofore has been the diffi-

culty of rolling the flanged iron sides. This, however, has been successfully overcome, and the new invention promises to come into rapid use.—3 *A*, *October* 18, 1873, 477.

NEW METHOD OF PRESERVING WOOD.

A new method of preserving wood from decay has been recommended by Hatzfeld. It seems that, in 1830, specimens of oak were dug up in Rouen which had been buried since the year 1150. This wood was quite sound, but had acquired a black color like ebony, and an astonishing hardness. Hatzfeld ascribed its preservation to the joint action of the tannin in the wood and the oxides of iron in the soil. Accordingly he now proposes to preserve wood artificially by means of tannin and the pyrolignite of iron, a combination which would in some measure bring about the same changes noticed in the specimens from Rouen. Hatzfeld impregnates the wood to be preserved, first with tannin, and subsequently with the pyrolignite solution. The latter substance has long been used by itself as a preservative of the best character, and it is doubtful whether the addition of the tannin, as proposed by Hatzfeld, will prove of sufficient advantage to warrant the extra expense.—8 *C*, *December* 25, 1873, 430.

THE AËROPHORE.

The aërophore, a new life-saving apparatus, is at present attracting much attention. It is specially designed to enable the workman or miner to enter a mine full of fire-damp, and to labor there with complete immunity from danger. Its continuous action seems to be its chief and very excellent merit. As designed for coal-mines, the apparatus consists of an air-pump, a regulator, a strainer, an air-tube, wound on a self-regulating coil, and a lamp.

The regulator, weighing about eight pounds, is strapped upon the back, and supplies the wearer and his lamp with fresh air. In construction, it is a metal box, so divided and fitted with valves that, on breathing into it, the breath is expelled and fresh air supplied to subsequent inhalation, at normal pressure and in proper quantity. One chamber is supplied with compressed air, obtained and kept up from the pump, and from reservoirs, where it is found impracticable to

place the pump within working distance, by reason of inaccessibility, or too great a length of connecting tube. The breathing-tube and mouth are of India rubber, the latter being held by the lips and teeth, in such a manner that none of the surrounding atmosphere can enter the lungs of the operator, the nostrils being closed by a clip, and the eyes protected by lunettes.

Armed with this apparatus, one may, upon an emergency, enter a mine full of foul gases, and thus possibly many lives may be saved that would otherwise be lost; or the state of workings may be ascertained without the risk that now often attends this operation, the workman penetrating with the aid of long tubes to a great distance, and remaining for hours if necessary. At a recent public trial of the apparatus, witnessed by a large audience of mine inspectors and others, its wearer remained with impunity, for a considerable length of time, engaged in various occupations, in an atmosphere of burning charcoal and sulphur. The company declared themselves convinced of the great utility of the new device.

BEACH-MINING FOR GOLD IN CALIFORNIA.

A communication has lately been made by Mr. A. W. Chase to the California Academy of Science, in reference to the beach-mining as prosecuted at Gold Bluffs, Klamath County, California. Many years ago a party of gold miners, encamping on this beach, found the sand filled with particles of the precious metal, and, much excited at the prospect, they made preparations to follow up the placer on a large scale; but, unfortunately, before they could get to work a heavy sea brought in a mass of gravel which covered the gold deposit. More recently, however, the work has been resumed, and, by carefully watching the best opportunity, a considerable amount of auriferous sand is secured from time to time. According to Mr. Chase, the gold really comes from a stratified bed of gravel, sand, stone, and lignite, which forms the vertical bluffs of the coast; and it is only after these bluffs have been broken down by the action of the waves that the gold is found on the beach. At present the mining consists in watching carefully, after a high sea, for a fresh exposure of auriferous sand, collecting this in bags, and carrying it on the backs of mules to the works.

The washing is done with the assistance of copper vessels, first coated with a little silver before the quicksilver is applied—the gold being in so extremely small particles that it requires this special measure for its extraction.

During Mr. Chase's visit, gold of the value of $1600 was obtained from the washings in six or seven days, with two machines; and $1700 were secured the succeeding week. Mr. Chase thinks the suggestion that coarser gold will be found at a distance from the mine at low water, and beyond the line of the surf, to be unfounded, and that, from his own observations, the gold follows the first two or three lines of breakers, and will never be found in paying quantities beyond.

Professor Dana, in discussing specimens of the sand, remarks that the red grains in the sand are garnets. He thinks it probable that the deposit dates partly from the close of the glacial era (that is, the time of the melting of the ice in the early part of the Champlain period, when floods and gravel depositions were the order of the day), and partly from the latter part of the Champlain period, when the waters were comparatively quiet.—*San Fran. Mining and Scien. Press, January* 24, 1874.

RESOURCES OF PERU.

Peru, as is well known, has been industriously occupied for several years past in the construction of railroads into various portions of her territory, with a view of opening them up for trade and settlement; the following being already finished, or to be completed within the present year—namely, from Ilo to Moquegua, 62 miles; from Mollendo to Puno, 337 miles; from Pisco to Ico, 25 miles; from Callao to San Mateo, 73 miles; from Chimbote to Taquilpon, 55 miles; and from Pacasmayo to La Viña, 92 miles.

As the Peruvian government is not able to develop the regions thus opened, it proposes to invite the co-operation of foreign nations in this direction, and is accordingly engaged in preparing for publication copies of the plans and profiles of the railways, with drawings of the most important engineering works on the lines, and a general map of the country; and a commission, consisting of Captain Ramon Azcarte, the state geologist, Don Antonio Raimondi, and Don Julio

Pflucker y Rico, has been appointed to collect samples, in triplicate, of the principal minerals and coal deposits which may be discovered, or are known to exist, in the region referred to, at a distance of not more than thirty miles from the railways which are to traverse it, and which from their character and condition promise profitable working.

Catalogues, drawings, and collections, as well as descriptions of the railways, are to be sent to the minister of Peru in France, to be printed in pamphlet form in English, French, and German, while the collections of minerals are to be placed on exhibition in London, Paris, and Berlin. The minister of the republic in France is authorized to grant free passage to and from Peru, in the steamers of the Pacific Steam Navigation Company, to miners of established reputation who express the intention of examining the mineral deposits of the republic, and to the representatives of companies formed with a minimum capital of one million pounds sterling for the purpose of working the mines of Peru, and with that object desiring to visit the scene of their proposed labor.—*Panama Star and Herald, February* 5, 1874.

ARRANGEMENT OF THE NEW HARBOR OF TRIESTE.

According to the plans of the imperial chief engineer, Josef von Mauser, the usual pile-work for securing vessels in harbors is replaced by a system of chains about 2.36 inches thick, forming a net-work over the bottom, to which are attached buoys carrying rings to which vessels may be fastened. The ends of the chains at the shores and piers are secured by being drawn through cast-iron tubes and held by rings, while the outer ends are anchored by masses of about 7400 pounds' weight. Three basins supplied in this way are calculated to accommodate ninety ships of the first class. The advantages claimed for the plan are that vessels are much less liable to injury in stormy weather, and that the buoys take up much less room, and are not liable to injury from the vessels. Shore fastenings are formed in a similar way by drawing a chain through cast-iron tubes, and securing each end by a ring, to which vessels can be attached; great economy of room being thus secured, and possibility of nearer approach of tracks for cars. The cost is not much greater than that of pile-work, while the method is adaptable

to greater depths, and requires no annual outlay for repairs. — *Vienna Circular.*

ATTACKS ON OCEAN CABLES BY MARINE ANIMALS.

In connection with the question of the possible injury to ocean cables by the action of submarine animals, to which we have already called attention in our pages, it is stated that when the French Atlantic cable, laid in 1869, was lately raised at one point for repairs about 112 miles west of Brest, it was found perforated by small boring mollusks, apparently of the genus *Xylophaga.* The outer covering of the cable consisted of tarred Manilla hemp, and was bored occasionally by round holes, in which their shells were found. In some places they had passed through the outer covering, and between the iron wires to the gutta-percha core, and in some instances they had actually made numerous shallow indentations, and laid bare the wire. Wherever examined, the cable was found covered by adhering masses of bryozoa, etc., which, however, appeared to produce no injury.—12 *A*, *November* 6, 1873, 15.

SELF-REGISTERING APPARATUS FOR OMNIBUSES, ETC.

A very ingenious apparatus was presented at the late exhibition of the Institution of Civil Engineers for recording passengers in omnibuses and street cars. This counts up once every minute the number of passengers, and prints this number and the exact time in plain figures. Each seat is separate, and the weight of the passenger on the seat brings the wire from the seat in communication with the recorder. The instrument also records the speed of the omnibus at every moment of the journey, and shows the exact time of arrival and departure from each station.—12 *A*, IX., 54.

PROCESS FOR DIMINISHING THE DIAMETER OF IRON OR STEEL CAR-WHEEL TIRES.

It sometimes happens that, by centring, etc., the interior diameter of a tire becomes so much too large that it will not fit the wheel. Such defects have been corrected, for a long time, by J. Fiedler, a German machinist, by heating the tire red-hot, and in that condition holding it half-immersed in cold water until cold; then heating again red-hot, and immersing the other half in the same way. In the first operation

the unimmersed hot portion must contract with the portion rapidly cooled, with a corresponding condensation of material, and consequent permanent diminution of diameter, and in the second operation a similar effect is produced on the other half. By these two operations an interior diameter of 34 inches can be reduced a quarter of an inch, and by four operations half an inch. The method given is not confined to tires, an instance being given where a ring of Bessemer steel, to be used as a flange-ring, had been entirely misshaped by an inexperienced workman, and was drawn into shape by heating fifteen times and cooling different portions.

ARTESIAN WELLS.

The irregularity of flow of artesian wells has been studied of late by Judge Caton, who has presented a paper on this subject to the Academy of Sciences of Chicago, in which he adduces some interesting phenomena, and very truly states that it is necessary to explain these phenomena in all their details in order that we shall become able to use the artesian wells to irrigate the great arid plains of the West; and without attempting a profound inquiry himself, he hopes at last to stimulate inquiry in this direction. He states that a well sunk by him at Ottawa, Illinois, at the foot of a bluff, passed first through 12 feet of earth, then 140 feet of sandstone, then 120 feet of lime rock, and, finally, 95 feet of Potsdam sandstone—in all 367 feet. During the boring of the well through the lime rock the water commenced flowing over its mouth, and every day the rate of discharge increased, until at the conclusion of the operation the flow was found to be about 64 gallons per minute, while if the head of the well was raised 15 inches higher, the flow was 55 gallons per minute. After piping the well and leading it into a tank, he soon observed that the water would sometimes only rise to the height of 11 inches above the floor of the tank, and he became satisfied that there was an irregularity in the flow of the well, and, in consequence, he ordered measures to be taken of the height of the water three times a day, which measures he presents for consideration, in full, during the months of October and November. The average of the former month shows that the water stood on the average highest at noon, while in the evening it was two inches lower, and in the morning one

inch lower still. He is not able to establish a definite period in the flow, although its irregularity is abundantly evident.

FOG-SIGNALS.

Professor Joseph Henry, chairman of a committee on fog-signals, has communicated a number of interesting observations made by him on the phenomena of sound as relating to the subject in hand. In studying the subject of fog-signals, it becomes a question of importance to ascertain whether waves of sound, like those of light, are absorbed or stifled by fog. On this point observers disagree; and to settle this question definitely the assistance of the pilots of the boats running between Boston and St. John, New Brunswick, has been secured, and they have promised to note the actual distance of a body from a given fog-signal when the sound is first heard on approaching, and again when it is lost on receding from it. Professor Henry considers it highly probable that fog does somewhat diminish the penetrating power of sound, but only to an exceedingly minute degree. Among the principal causes of the diminution in this penetrating power are enumerated the varying density of the atmosphere, the direction of the wind, and the reflection of the sound wave from neighboring objects, such as hill-sides, forests, houses, etc. According to General Duane, it appears that although a reflector, in the focus of which a steam-whistle or ordinary bell is placed, reflects the sound a short distance, it produces little or no effect at the distance of two or three miles. In the case of signals that were sounded at the side of a bank with a large house directly in the rear, the roof of which would tend to deflect the sound forward, it was shown that this sound shadow vanishes at the distance of a mile and a half or two miles, and that at the distance of three miles the sound was quite loud. The fog-signals have frequently been heard at the distance of twenty miles, and as frequently can not be heard at the distance of two miles, and this with no perceptible difference in the state of the atmosphere. This case, although quite abnormal, seems to be sufficiently well authenticated to justify its publication under the authority of the Light-house Board. The instruments employed as fog-signals by this board are mainly three, all constructed on a principle of resounding cavities, in which the air is the sound-

ing body. These instruments are, first, the reed trumpet, the air being condensed by a caloric engine; second, the siren trumpet, the revolving disk being driven by steam from a high-pressure boiler; third, the ordinary locomotive whistle blown by steam from a high-pressure boiler.—*Proc. Nat. Acad., N. Y. Tribune, October* 31, 1873.

SAWDUST AS FUEL.

The expense of forming sawdust into compact blocks, in which, like turf, tan, etc., it is best adapted for fuel, leads many to be satisfied with smaller heating results in burning it in a loose condition. A much better effect may, however, be obtained under such circumstances by adding about one sixth their weight of mineral coal: the high temperature produced by the combustion of the latter causing a more rapid expulsion of the 25 to 40 per cent. of moisture present in the sawdust, as well as a more rapid development and more complete combustion of inflammable gases. For the best effect, however, a peculiar grate is necessary.—6 *C, January* 8, 1874, 18.

EXPLOSION OF GUN-COTTON.

For a long time Professor Abel, at Woolwich, has been conducting experiments upon gun-cotton; and very lately he has obtained results of unusual interest. In the first place, he finds that the explosion of gun-cotton is, so to speak, sympathetic, varying according to the manner in which it is begun. If, in the form of yarn, the gun-cotton be ignited by a spark, it smoulders slowly away; a flame causes it to burn rapidly; fired as a charge, it behaves with corresponding vigor; and exploded by a fulminating powder, it acts with tremendous violence. Every fulminating powder, however, will not explode gun-cotton, it seeming to need a peculiar set of vibrations to which alone it will respond. Fulminating mercury, the ordinary powder of percussion-caps, seems the best agent for this purpose. If gun-cotton, compressed into cakes, be arranged in a line, and a cake at one end detonated by the fulminate, the detonations follow each other along the line with marvelous velocity—a velocity, according to the electric chronoscope, of about 20,000 feet, or nearly four miles per second. When we recollect that a rifle-bullet usually travels

only about 1300 feet, and sound only 1090 feet, per second, we can partially realize this extraordinary velocity. Only the speed of the planets in their orbits, and the rapidity of light and of radiant heat, can be compared with it. Another remarkable feature is that, by means of fulminating powder, wet gun-cotton may be exploded as readily as dry. Wet gun-cotton has hitherto been considered absolutely non-explosive, and, indeed, is so as far as regards flame: thrown upon a fire it acts like a wet blanket. But to the fulminating powder the cotton, though soaking wet, responds instantaneously. A quantity of it inclosed in a common fishing-net, and provided with a dry primer and a fulminate fuse, will explode under water as violently as if confined within a water-tight steel case. Here opens a new field for the makers of submarine torpedoes. Some other new applications of gun-cotton have been suggested. If several mines are to be exploded simultaneously, they can be connected by lines of gun-cotton cakes, and the velocity already mentioned made useful. If palisades are to be destroyed, disks of gun-cotton exploded against them will do the work effectually. And if a large tree is to be cut down, a necklace of such disks hung around the trunk will, when detonated, act as thoroughly and as neatly as an axe.—12 *A*, *October* 23, 1873.

PREVENTION OF BOILER INCRUSTATION.

The process of Dr. De Haen, consisting in the treatment of the feed water with the proper amount of baric chloride and milk of lime, as determined by quantitative analysis, seems to grow in favor for locomotive and stationary engines, and is to be employed for the 310 boilers of Krupp's steel foundry at Essen.—6 *C*, *March* 5, 1874, 94.

DANGER-NOTICE TO LOCOMOTIVE ENGINEERS.

According to General Morin, a method has been in successful operation for a year on the line of the Northern Company of France for informing the driver of a train whether the way is open or not. According to this arrangement, the signalman, when he turns the disk, sends an electric current, in the direction of the coming train, to a bar placed between the rails; and when the engine reaches the spot, a metal brush, placed between the wheels, sweeps the cross-bar, the current

passes to the engine, and, by means of an electro-magnet, presses upon a lever which opens the steam whistle, thus making it virtually automatic.—3 *A*, *April* 11, 1874, 454.

CHECKING UNCOUPLED CARS ON A DOWN GRADE.

A portable stand was constructed for this purpose by Semann, cut in the form of a quadrant, prolonged into tongues about four feet long, resting upon the rails. When the signal is given that a car has become detached, the road-watcher places this on the track, with the tongues toward the car, the fore wheels of which run over the tongues into the curved recess, and push the apparatus along the track; and the sliding of the tongues and the stopping of the wheels soon check the car.—6 *C*, *January* 22, 1874, 38.

A NEW STEAMBOAT PROPELLER.

A new propeller for steamers has lately been introduced by Dr. Collis Brown, which differs materially from the screw propeller at present in use, resembling, when at rest, the letter X, and claimed to possess many advantages over its predecessors. These are stated to be absence of vibration; reduction of wear and tear to machinery; ready adaptability to any screw steamship; and facility of checking a ship's way, with the power of driving her full speed astern in a few seconds on reversal, as well as giving considerable increase of speed and effecting a great saving of coal. During a trial with the steam-yacht *Lapwing*, under a pressure of fifty-eight pounds of steam, with a consumption of eighty-one pounds of coal per hour, the propeller made 220 revolutions per minute, with the tide slack, and the furnace burning hard steam coal; the measured mile being run in five minutes.—3 *A*, *December* 27, 1873, 804.

HEATING POWER OF WEATHERED CINDERS.

The efforts at utilizing cinders for building purposes have not succeeded very well; and attempts to burn them have also been unsuccessful, on account of the melting slag which chokes the draft in a short time. According to a communication to the Westphalia Engineers' Association by Chary, when condensed air is passed over glowing cinders in a furnace the carbonic oxide formed affords a flame several feet

long, suitable for heating boilers, etc., and the experiments, as far as they go, indicate a heating power in the cinders (from which the larger pieces of slag have simply been separated by hand) equal to that of half their weight of coal. A convenient method of separating the slag seems to be the great desideratum. Washing the cinders requires too much room for drying, and even then they will retain considerable moisture. A current of air, as employed in winnowing grain, has been suggested.—14 *C*, CCIX., 236.

PURIFICATION OF HARD WATER FOR STEAM-BOILERS, ETC.

After a full discussion of the various methods for purifying hard water for feeding boilers and manufacturing purposes, Stingl concludes that the only trustworthy method is that of precipitating the impurities by the proper quantity of a suitable chemical agent or agents, and removing the precipitates in an approved way. The defects in the previous applications of this method have been so far removed by Béranger, in his patented process, that it is used with success in a number of establishments. Omitting the detailed working description of the complete but simple apparatus employed, the main features seem to be the precipitation of the foreign matters by lime-water, or lime-water and chloride of barium (the requisite quantity of these substances to be accurately ascertained by volumetric analysis of the water), using for the purpose standard lime-water instead of soap solution, as in previous processes. During the progress of the purification, the least excess or deficiency of lime-water can be detected by accurate and easy tests, and can be remedied, thus keeping the operation completely under control. The water is finally passed through a very simple, efficient, and cheap filter of shavings and refuse coke, which not only delivers it clear, but remains effective for several months.—14 *C*, CCIX., 175.

FUEL BURNING WITHOUT SMOKE (PYROLITH).

A fuel burning without smoke, needing no attention after lighting, and said to be especially adapted to heating railway cars, has been patented in England. It consists of a mixture of pulverized charcoal or coal with some material affording oxygen when heated, as nitrate or chlorate of potash, etc. Some cementing substance, such as gum, starch, or water-

glass, is employed to form it into cakes, which are compressed and dried at a gentle heat. Special apparatus has been devised for its combustion.—5 *C*, xxxix., 311.

CONDENSATION OF STEAM BY COLD SURFACES.

An investigation by Reynolds, Professor of Engineering in Owen's College, Manchester, on the condensation of a mixture of air and steam upon cold surfaces, has important practical bearings in the management of the steam-engine. His objects were to ascertain if there is a great difference in the rates of condensation of pure steam and a mixture of steam and air; and, again, to ascertain if the effect of the mixed air on the condensation increases as the proportion of air to steam increases. The rate of condensation of pure steam is so great, when it impinges upon a cold surface, that it is practically impossible to measure it; wherefore indirect methods of investigation were necessary. The conclusions drawn from his experiments are as follows: First, that a small quantity of air in steam does very much retard its condensation upon a cold surface; that, in fact, there is no limit to the rate at which pure steam will condense, except the power of the surface to carry off the heat. Second, that the rate of condensation diminishes rapidly, and nearly uniformly, as the air that is present increases in a proportion of from two to ten per cent. of the steam, and then less and less rapidly until 30 per cent. is reached, after which the rate of condensation remains nearly constant. Third, that, in consequence of this effect of air, the necessary area of surface of a condenser for a steam-engine increases very rapidly with the quantity of air allowed to be present within it. Fourth, that by mixing air with the steam before it is used the condensation at the surface of the cylinder may be greatly diminished, and consequently the efficiency of the engine increased. Fifth, that the maximum effect, or nearly so, will be obtained when the pressure of the air is one tenth that of the steam.—*Proc. Roy. Soc.*, 1873, 280.

SIMPLEST STEAM-MOTOR.

The solution of the problem how to utilize the expansive force of steam in the simplest manner, so as to produce a continuous rotary motion, is furnished by an invention of Pro-

fessor Siemens, as lately published in Dingler's *Polytechnic Journal*, and warmly recommended for the propulsion of sewing-machines and other forms of the lesser industries. The motion of the machine commences directly with the action of the steam, and the steam-generator itself rotates.—18 *A*, *September* 5, 1873, 624.

HOCK'S PETROLEUM MOTOR.

In the imperial printing-office at Vienna, three presses, of a capacity of 1200 sheets per hour, are driven by a motor invented by Hock, which promises to be very useful for small industrial establishments. Combustion of petroleum in the working cylinder, and the heat developed by it, constitute the motive power. The machine is said to be very regular in action, to be entirely free from danger, to require little attention, to occupy little space, and to be very economical in running, 1½ pounds of petroleum per hour being reckoned for one horse-power. Like the gas-engine, it is also ready at all times, and it is easily cooled down.—14 *C*, CCXII., 73.

TRIAL OF THE AMERICAN COAL-CUTTING MACHINE.

The first practical trial of an American coal-cutting machine was recently made at the Coal Brook mines of Messrs. Niblack, Zimmermann, & Alexander, a few miles from Brazil, Indiana.

The machine in question is known as Brown's Monitor Coal-cutter, and consists, according to the description given of it, of a five-horse-power steam-engine, driven by steam that is carried into the mine by a steam-pipe, terminating in a flexible hose of rubber, so as to permit freedom of motion in the machine. It is intended to substitute compressed air for steam upon the termination of the experimental trials. The cutting arrangement is an iron rim of four feet in diameter, which has on its periphery movable steel teeth placed at points twelve inches apart. These teeth may be taken out and ground whenever they become dull. The construction and operation of the cutter is such that it can be inserted to a depth of three and a third feet, or seven eighths of its whole diameter. The machine runs on a movable track, and is fed by a screw movement. The track is laid along the side of the coal at the proper distance from it, and when a

cut has been made the whole length, the machine is put on trucks and wheeled to the next room, where the track is laid as before, and so on through the mine. The machine will cut a distance of a yard in five minutes. The economy obtained by the use of the machine is estimated at thirty-five cents per ton over the hand labor of miners. This would prove a large saving, even in limited operations.

It has been commonly supposed that much of the success which has attended the employment of machines for a similar purpose in England is attributable to the thinness of the English coal veins, which run about two feet four inches to two feet ten inches, while in the United States the bituminous veins vary from four feet to eight feet, and the anthracite often from twenty-five to forty feet. In the Indiana mines the average thickness of the seams will not be far from that of the bituminous estimate. Further and more extended trials will be anticipated with much interest. Those who favor the undertaking in the English mines believe that a force of 60,000 men with the machines can raise Great Britain's annual product of 120,000,000 tons, which now requires the labor of 360,000 men.

PETROLATE, A NEW FUEL.

M. Pogliani has lately devised a new combustible, which he calls "Petrolate." He employs in its manufacture certain refuse carbonaceous materials, thereby making an artificial fuel which is claimed to be very cheap and of great value. His first formula is—of distilled petroleum, 20 parts; colophane, 30; charcoal-dust, 40; mineral coal-dust, 30; sawdust, 6; and sulphate of lime, 10. The petroleum is to be placed in a metallic vessel heated by steam to 167° Fahr. As soon as the colophane is dissolved, the other substances are introduced and stirred together, and the mixture is then run off into moulds, and when cold it becomes hard. In another formula, 25 parts of crude petroleum-oil are substituted for the 20 of distilled petroleum. In the opinion of M. Pogliani, the petroleum combines chemically with the colophane, and in its combination, and the mixture with other substances, produces a complete solidification. The combustion of the fuel produced is quick, and prolonged, with a brilliant flame, until every thing is consumed. The calorific power of the

combustible is said to be more than double that of coal; so that with 1000 pounds of the new material M. Pogliani claims to have secured a result equal to that of 3000 pounds of common coal. For this reason its use is urged for steam-vessels, especially those which are obliged to remain a long time at sea without the means of renewing their supply.—3 *B*, *November* 6, 1873, 403.

SYSTEM OF OPTICAL TELEGRAPHY.

A system of optical telegraphy, somewhat like that devised in France and Italy, has been announced by Mr. Gustin, of Troy, who uses an instrument like a head-light to a locomotive, with a shield that fits over and shuts off the light. The operator sits behind, and an attachment, worked by the hand, lifts the shield, throwing forward the flash of light. A single flash stands for a dot, and a prolonged one means a dash. While the French and Italian systems have given very gratifying results, although not specially adapted for use in the field, Mr. Gustin's method, on the other hand, is designed especially for use at a moment's notice. Some objections have been made against it by the authorities at Washington, but the inventor thinks these have but slight foundation.—*Elmira Daily Advertiser*, *October* 3, 1873.

THE AUTOMATIC SYSTEM OF TELEGRAPHY.

The automatic telegraph system has been now for nearly two years in operation between New York and Washington, and it has proved itself a remarkable success. It is unquestionably the most rapid, unerring, and, at the same time, economical system of transmission which has as yet been devised or introduced into practical use. By it has been attained the rate of 1500 words per minute, on a line 250 miles in length. The President's Message, of 12,000 words, was punched and transmitted from Washington to New York in about twenty minutes.

Mr. Little's system consists principally in the use of a condenser for clearing the wire of a static charge of electricity, and for the absorption of extra currents induced in the helices of the magnets inserted in the main line. These extra currents are brought about by making or breaking the battery contacts. This condenser could be applied with

great advantage to the Morse instrument now in daily use.

Another feature of the Little system is the application of an adjustable rheostat; and a third important feature is the introduction of the "lighting blade," which prevents over-winding and breaking of the paper strip. Some forty minor points in connection with his instruments have justified special patents; among which may be mentioned the punching and perforating machinery, which is a feature common to other instruments, and will probably come into very general use.—*The Telegrapher*, *December*, 1873.

PRIZE FOR RAILWAY LAMPS.

The Society of Arts of London offers a gold medal or twenty guineas for an improved lamp, or means of illumination, suitable for railway passenger carriages, that shall produce a good, clear, steady, durable, and safe light. It must be simple in construction, and capable of being readily cleansed and repaired. In judging the merits, the cost will be considered. Specimens in a condition suitable for trial are to be sent to the society's house not later than the 1st of November, 1874. The council reserve the right of withholding the medal or premium offered, if, in the opinion of the judges, none of the articles sent in are deserving of reward.—23 *A*, *May* 29, 1873, 661.

STRENGTH OF PERFORATED IRON PLATES.

According to experiments by Kirkaldy, the diminution of the strength of iron plates by punching and boring for riveting is not entirely accounted for by the loss of the metal removed. The breaking weight for a unit of surface of the metal remaining was found to be, on an average, 34 per cent. less for the punched ones, and 23 per cent. less for the bored ones, than for the unperforated plates.—6 *C*, *April* 16, 1874, 158.

PRESERVATION OF WOOD.

In a recent communication to the French Academy, M. Hatzfeld, after presenting a very concise statement of the present condition of practice in this branch of technology, proposes the employment of the tannate of the protoxide of

iron as a cheap and efficient preservative of timber. He bases his statement upon the assurance that the decomposible nitrogenous and albuminous matters contained in the juices of the tree, to the presence of which its decay is to be ascribed, will, by the injection of a tannate, be changed to insoluble and very stable compounds; or, to speak technically, there will be formed albuminous tannates, analogous in their properties to the gelatinous tannates formed in the tanning of animal skins. In addition to this tanning process, he urges that the gradual oxidation of the iron will cause it to deposit itself in a solid state in the intercellular spaces, and thus effect a species of petrifaction, thereby materially adding to the hardness of the timber, and rendering it more valuable for many industrial uses. In carrying his plan into execution he proposes to use the method of injection invented by Boucherie (vital suction, or the pressure of a liquid column), and either to employ the tannate at one operation, or to inject the tannic acid, and follow this with any soluble salt of iron.

HYDRAULICS OF GREAT RIVERS.

The *Athenæum*, in a highly commendatory notice of a work by Révy upon hydraulics of the great rivers, especially of the Parana and Uraguay and the estuary of the La Plata, refers to a generalization obscurely indicated in the work, and which the reviewer thinks, if absolute, may be called Révy's law, stating it in the following terms: "The inclination of the surface being the same (and no interference arising from other causes), the velocity of a river is as the square of its depth."—15 *A*, *August* 22, 1874, 284.

EXPLOSIONS OF FIRE-DAMP IN COAL MINES.

The subject of the connection between explosions in coal-mines and the weather has attracted the attention of Messrs. Scott and Galloway, in England, during the past four years. Their third report has recently been presented, covering the year 1873; from which it appears that the number of fatal explosions was seventy, causing the loss of one hundred and sixty-three lives. Of these explosions, 58 per cent. are due to changes of barometric pressure; 17 per cent. to great heat; 25 per cent. are not attributed to meteorological agen-

cies. The number of explosions is not found to have any apparent dependence upon the direction from which the wind blows. The results place it beyond the possibility of a doubt that the escape of the fire-damp, and the consequent explosions, are related mainly to the conditions of atmospheric pressure, and that a careful watch over the barometer is, above all, necessary in each colliery.—12 *A*, X., 158.

CANAL THROUGH THE ISTHMUS OF CORINTH.

The contract for cutting a canal through the Isthmus of Corinth has been granted to a capitalist in Athens on the following terms: The canal is to be twenty-seven feet deep, and one hundred and forty in width at the bottom. Near the middle of its extent there is to be a dock, having a surface of 400,000 square yards. The whole is to be done in six years. The precautionary deposit is fixed at 300,000 francs, and the concession is to last for ninety-nine years. The cost is estimated at about $4,000,000.—8 *B*, *November* 8, 1873, 456.

THE SCZAROCH.

The Russians, it is said, have adopted a new shell, which from its formidable character, as shown in recent experiments, is attracting much attention on the part of military authorities. The following description of the new projectile is going the rounds of the scientific press: It is well known that the ordinary elongated bolt will not permit of a ricochet fire, and as this species of firing is very effective against masses of troops, the loss is a matter of considerable moment. The sczaroch, as the new projectile is called, is either a percussion or a time shell, combined with a shot. The latter ricochets beyond the point of explosion of the bursting charge. The shell portion is a simple iron cylinder, to one end of which is secured by a thin sheet of lead a spherical shot. On leaving the gun the combined projectile acts like an ordinary elongated shell, but as soon as the explosion of the charge takes place the cylinder flies in pieces, while the shot, impelled with the additional velocity, ricochets for hundreds of feet ahead. In firing at batteries, it is claimed that the double effect of this projectile comes into excellent use, as the shell might be exploded among the guns, while the ball would strike far in the rear among the reserves; or

while the shell might burst in the front rank of an advancing column, the ball would continue its course through several succeeding columns.

CELLULOSE-DYNAMITE.

Trauzl has succeeded in producing a nitro-glycerine powder, possessing all the advantages of infusorial-dynamite, and also that of gun-cotton in its indifference to the action of water, by employing the property of certain organic substances, discovered by him, of absorbing nitro-glycerine, and retaining it completely in water, in a condition perfectly capable of explosion. Instead of nitro-cellulose and gun-cotton, first used for the purpose, he employs a peculiarly prepared cellulose, which takes up 70 to 75 per cent. of nitro-glycerine, and forms an explosive, which remains constant in composition under water, and after pressing out and drying acquires its previous explosive force completely; and which, when mixed even with a large amount of water, can be exploded with great effect by means of fulminates or cartridges, but not by merely mechanical means.—6 *C*, *April* 2, 1874, 136.

LIPPMANN'S SMALL ELECTRO-CAPILLARY MOTOR.

The following principle has been applied by Lippmann in the construction of a very novel, small motor, producing one hundred revolutions per minute, and which is so exceedingly sensitive to the slightest electrical current that its use for electrometrical purposes is suggested, as well as its possible adaptation to the reception of messages by ocean cables. If a globule of mercury, several millimeters in diameter, covered with water acidulated with sulphuric acid, and but slightly colored with bichromate of potash, in a glass or porcelain vessel, is touched on the side with an iron point, it at once contracts, thus altering its shape, again expands until it touches the needle point, then again contracts, and so on, giving rise to curious reciprocating movements. This peculiar effect is due to the alternate oxidizing and deoxidizing effect of the bichromate and iron on the mercury, whereby its capillary properties are modified; and a similar phenomenon is produced when the mercury is alternately connected with the positive and negative poles of a galvanic cell. In applying the force thus generated on a large scale, Lipp-

mann placed two vessels of mercury in a glass trough filled with acidulated water, and with pistons, composed of capillary tubes filled with mercury, inserted into the vessels of mercury; the alternate contraction and expansion of the mercury in the pistons, as they are connected with one or the other pole of a galvanic battery, furnishing the motive power in the case.—14 *C*, CCXII., 300.

SCIENTIFIC BALLOON ASCENSION.

A balloon ascension made on the 2d of November, 1873, at Charkow, in Russia, by Bunelle, is worthy of special mention. In 8½ hours the balloon traveled 190 kilometers, going always in the same direction toward the N.N.E. The greatest altitude was about nine thousand feet; and the small quantity (thirty-five pounds) of ballast used shows how well the aeronaut managed the length of his voyage. The movement of the lower strata of air was always greater than that of the upper strata. At an altitude of three thousand feet the hourly velocity was twenty-one miles, while in the immediate neighborhood of the earth the force of the wind was so great that Bunelle could with difficulty effect a landing. The shadow of the balloon on the earth was a very well-defined black spot, whose movement across the country gave, by means of an accurate map, the means of determining the velocity of the current of air. At sunset a heavy rain-fall was experienced in the interior of the clouds. Above the clouds the aeronaut found a beautiful sky and a very pleasant temperature. The condition of the atmosphere appears to have been directly the opposite of that experienced by Glaisher on July 11th, 1863. The latter found himself in a northerly current, which was warmer the nearer he approached the earth.—*Heis*, *Wochenschrift*, 1874, 154.

RUSSIAN *versus* WELSH COALS.

Chief-Engineer Isherwood, of the United States Navy, in a report on the investigation of the value of Russian coal from the basin of the River Don, states that the deposits of this coal, which are now being mined, are immense. Some of it has an exceptional purity, yielding only two or three per cent. of ash. The calorific effect has been carefully investigated, the result being to disprove the reliability of the law

of Dulong, which assumes the calorific effect of coal free from moisture to be the sum of the calorific effects of all its combustible elements, less the proportion of hydrogen required to form water with the whole of its oxygen. The coals in question gave—experimentally—a calorific effect from three to twelve per cent. higher than that obtained by the calculation according to Dulong's law. Among the numerical values quoted by Isherwood, the following are of interest:

"The number of pounds of water that were raised 1° Fahr. in temperature by the burning of one pound of crude coal or lignite, as found by direct experiment, was for

The Groucheaski anthracite	14.189
The Mioucki coal	15.383
The Galouboski coal	13.509
The Toula lignite	10.429

These numbers are in all cases, as above stated, considerably less than those calculated according to Dulong's law.

"The Welsh coals ordinarily used in the British Navy are the Bwelf and the Powell, which respectively have calorific effects of 15.804 and 16.108 of the above units."—1 *D*, IX., 370.

FILLING THE DEPRESSION IN THE DESERT OF SAHARA.

Considerable discussion is now going on in reference to the propriety of the proposed plan of the French government of filling a depression in the Sahara Desert by allowing the entrance of water from the Mediterranean; many questions arising as to the effect, not only upon the country, but upon the regions north of the Mediterranean.

It is well known that the sirocco (or the *Föhn* of the Germans), after crossing the Mediterranean, expends itself upon the snows and glaciers of the Alps, and tends in a considerable degree to prevent their undue extension, as in an earlier geological period. Many persons fear that, should this depression be filled with water, the proper amount of dry heat will not be produced to regulate the glaciers, and that in consequence they will probably extend far into the plains, and perhaps in a measure reproduce the climatic conditions that existed during the reindeer period, the evidences of which are so abundant in Southern Europe.

This has been stoutly contested by other writers, who insist that the effect of so comparatively small a surface will not be appreciable in this way, but that it will involve a very beneficial change in the climate of North Africa, whereby the regions adjacent to the new lake will experience a succession of showers, by which they will become comparatively fertile.

Professor Le Verrier, who takes the latter ground, refers to the beneficial action of water in the little thread of the Suez Canal, and infers from it what will be the result in the evaporation from a surface about one hundred and sixty miles long and twenty-five to thirty broad.

In further objection to the proposition, Mr. Houyvet remarks, in a communication to the French Academy, that it will not be difficult to establish this sea; the problem will be how to keep it up. Supposing, however, according to his communication, the sea to be established by means of a canal, it will lose an enormous quantity of water by evaporation every day, without the introduction of an equal volume of fresh water. The water evaporated being replaced by a supply coming through the canal, the whole body will soon reach the maximum of saturation. The evaporation still continuing, a deposit of salt will be formed, which in time will fill up the whole space of the interior sea, and the salinity of the water will be such that no animal life can be sustained in it, and the ultimate result will be simply the accumulation of an immense deposit of salt.

The projectors are very strongly of the opinion, however, that the presence of this water and its evaporation will produce copious rains, which will in large measure return into the sea, and not only accomplish the object referred to, but also convert what is now a sterile waste into a fertile country.—13 *A*, *July* 25, 1874, 98; and 6 *B*, *July* 13, 1874, 102.

STEAM-PRESSURE INDICATORS.

A most exhaustive experimental investigation, by Professor Berndt, into the accuracy of the indicator diagrams used in connection with steam-engines, has been published at the Chemnitz Industrial School. The want of accurate knowledge on this subject seems to have justified Professor Berndt in the thoroughness of his inquiry.

The "Richards indicator" and the "Ashton & Story indicator" are two instruments specially examined by Berndt; and in these the expansion and contraction of free springs, at ordinary temperatures, are employed as the means of measuring the pressure of the steam—a very marked superiority being manifested by the latter instrument, so long as the spring is not warmed in consequence of the work that it is called upon to perform. Even when so warmed, it seems to have a decided advantage over the Richards indicator.—*Programme Ind. School at Chemnitz*, 1874.

THE THIRTY-FIVE-TON STEAM-HAMMER.

The great steam-hammer lately built for the Royal Gun Factories at Woolwich has been successfully erected and set to work. Being much the largest piece of mechanism of its kind in the world, considerable interest attaches to its performance. The weight of the falling portion is nearly 40 tons, and its force of impact is greatly augmented by the use of steam to drive it down from the top, the augmentation being estimated to equal the force represented by allowing the hammer to fall, of its own weight, from a height of 80 feet. It has been allowed a striking fall of 15 feet 3 inches. The hammer is 45 feet high, and covers, with its supports, a base of about 120 square feet. Its weight is about 500 tons above the ground, and the iron used in the foundation below weighs 665 tons.

THE USE OF AMSLER'S PLANIMETER.

The well-known planimeter of Amsler, that has during the past ten years taken so prominent a position as an accurate assistant in all engineering calculations, has had a new use suggested by Kopcke, who, at a recent meeting of the Association of Engineers and Architects, at Leipsic, explained how the planimeter may be employed for the determination of the cubic contents of embankments, excavations, and other similar problems. If to this new use we add the application suggested by Professor Frankel, to the determination of the weight and strength of trestles and beams, it becomes evident that the planimeter is destined to occupy a still more important place in the engineer's office.—*Protokolle Sächs. Ingenieur Verein*, 1873, 3.

A METHOD OF RAISING AND LOWERING THE SCREW OF A PROPELLER.

Mr. Harland, of Belfast, gave an account before the British Association of his method for raising and lowering the screw propeller in ships, remarking that during some voyages, and especially across the Atlantic, the wave line of the side of the ship was very often such as to leave an ordinary screw half exposed. Under these circumstances the engine has only half work to do, and consequently is apt to run off at such speed as to injure the machinery. To prevent this he has devised a simple method of lowering the screw, enabling the engineer in heavy weather to keep the vessel going much steadier, with very little reduced speed. A large amount of power was thus utilized, with the advantage of a uniform motion. In the normal position of the screw the tip should be in a line with the keel; but when the vessel is in more water than she really requires, the screw can be lowered, involving no change in the speed of the engine. To prevent the screw coming in contact with fishermen's nets, or other obstacles, a small shoe can be slipped under it if necessary. Mr. Harland's invention includes also a method of elevating the screw, to avoid contact with ice or other floating objects, and to enable it to be repaired without the necessity of actually taking the vessel into dock. The operation of raising and lowering the screw is readily and rapidly performed by means of a small engine on the deck.—15 *A*, *August* 29, 1874, 287.

PROPOSED CANAL THROUGH THE DESERT OF SARDAR ABAD.

While the French are proposing to cut a canal from the Gulf of Gabes, for the formation of an immense sea in Algeria and Tunis, Mr. Hobham is about attempting to divert the waters of the Arpatchai into a channel to be cut throughout the length and breadth of the vast desert plain of Sardar Abad for its thorough fertilization and cultivation. The work has already been begun, under the grant of the plain from the Russian government, and it will probably cost five millions of roubles for its completion. Mr. Hobham hopes to attract one hundred thousand Irish and German immigrants to settle on the reclaimed lands.—13 *A*, *Sept.* 4, 1874, 263.

M. TECHNOLOGY

FIXING DESIGNS ON GLASS.

According to a process patented by E. Dodé, the surface of the glass is first finely ground, and any design then painted on it with a mixture of anhydrous boracic acid, gum, and water. When dry, it is exposed to a temperature at which the boracic acid fuses, and imparts to those portions of the glass the usual lustre, and thus fixes the drawing. By mixing various metallic oxides with the boracic acid, designs in color may be produced.—15 *C*, 1873, xxiv., 384.

PHOTO-STEREOTYPING.

It is stated by Fink that metal plates which can be employed in connection with ordinary type can be prepared from photographic negatives, according to the following simple process: A solution of 1 ounce of bichromate of potash in 15 ounces of water is slowly warmed, and 2 ounces of fine gelatine gradually added. When the latter is completely dissolved, and the liquid has about reached its boiling-point, it is filtered through fine linen. A piece of plate-glass, several inches larger each way than the proposed picture, is coated, in the dark, by pouring some of this solution on the centre while the plate is in a horizontal position, distributing the solution to the margin by means of a fine brush, and repeating the pouring until a film about one eighth of an inch thick is formed. It is then allowed to dry, which will require two to three days, and is afterward exposed under a transparent collodion positive, taken from a negative of the object, to diffused light for ten to thirty minutes, and then treated, in the dark, with lukewarm water in a tray, until the relief is fully developed, which will be in from five to ten minutes. After drying it with filter-paper, it is brushed with glycerine with a fine, large, soft brush, the excess being removed with filter-paper. A plaster matrix is formed from this relief by pouring on it, while held in the hand, fine plaster mixed with water to the consistency of oil, and tapping it gently on the under side to remove air-bubbles, then

placing it perfectly level, and pouring on it a thicker mixture of plaster and water, until the layer is about four tenths to five tenths of an inch thick. After fifteen to eighteen hours it can be taken from the relief, by removing the thin edges of the plaster with a knife, and gently pressing; and it is then fit for the type-founder, after being retouched, if desired at any points, with a needle.—14 *C*, 1874, CCXI., 318.

CLEANING AND BLEACHING OLD COPPER-PLATE ENGRAVINGS.

The brown tint in the paper of old engravings, as well as any ink spots, insect stains, etc., may be removed by first erasing with India rubber or bread-crumbs such stains as yield to them, and then laying the engraving on gauze, secured in a light frame, and moistening the spots with a solution of one ounce of oxalic acid in one pound of water. When these have disappeared, the engraving, on its gauze support, is to be immersed in lukewarm water, and occasionally moved gently forward and backward for about twelve hours. The dirty water is then to be replaced by fresh, and chloride of lime solution dropped into it until the smell is appreciable, in which the engraving is to remain immersed for six hours, with occasional gentle agitation. Any brownish tint remaining will bleach out immediately on the addition of a few drops of hydrochloric acid, and the lights and shades appear in their original purity and sharpness. The solution must then be replaced with clear water; and the engraving, perfectly freed from the chloride bath, must be dried in the air, and pressed in that condition.—5 *C*, 1873, XXXVI., 2.

PAUL'S NEW METHOD OF LITHOGRAPHIC TRANSFERS.

A new method has lately been announced by M. Paul for transferring a photographic image upon stone by the process of photo-lithography. The ordinary method consists in producing a positive image on gelatinized paper treated with bichromate of potash. After exposure, it is entirely covered with a fatty ink, and then washed with warm water to remove the unaltered gelatine. The image remains with its black coating of lithographic ink, and is next, by a well-known process, transferred upon a stone suitably prepared. Images thus obtained, however, lack sharpness of outline,

because the warm water produces a swelling of the undissolved gelatine, and softens the lithographic ink. As a consequence, when transferred to stone, which requires a certain pressure, the softened portions are flattened out, and produce blisters or irregular contours.

This inconvenience is obviated by Paul's method, which consists essentially in the substitution of albumen for gelatine, so that the washing can be done with cold water. The paper is covered with a layer of albumen, combined with a concentrated solution of the bichromate of potash. After a sufficient exposure under the negative, the paper is covered with lithographic ink, then immersed in cold water to dissolve the unaltered albumen, which is taken away with a soft sponge. A very sharp picture is thus produced, which can be transferred to stone.—3 *B*, *November* 27, 1873, 553.

PHOTO-ENGRAVING.

Material progress is made in the application of photography to various branches of engraving. The arts of photo-lithography and photo-plate printing have lately been supplemented by certain processes which are called by those who employ them "photo-engraving." These operations, though their details are jealously kept secret, may be safely said to depend largely upon producing, by means of bichromatized gelatine, from an ordinary glass negative of the drawing or engraving, a relief-plate in metal, either an electrotype or stereotype, as may be desired. This may then be employed as usual in the printing-press. Original pen drawings and copies from wood-cuts, steel or lithographic engravings, are reproduced with exquisite fidelity, and, it is said, very cheaply. The ability to employ a relief-plate in the printing-press, of course, greatly lessens the expense of subsequent printing, as compared with other methods. Photo-engraving of the character here referred to is at present carried on in New York and Philadelphia.

BLACK INK FOR MARKING BOXES, ETC.

A cheap and beautiful article may be prepared by dissolving 10 parts of extract of logwood in 500 parts of water, and adding 2 parts of yellow chromate of potash. It should be stirred with a brush on using.—26 *C*, 1874, VI., 56.

A NEW AND DURABLE INK.

According to Böttger, a rapid-drying, brilliant ink, which resists tolerably well the most powerful chemical reagents, may be made by triturating carmine with some solution of water-glass in a porcelain mortar, and diluting with water-glass solution until it flows readily.—8 *C*, *August* 14, 1873, 269.

IMPROVED COPYING-INK.

According to the *Revue Horticole*, an ink, invented by Mr. Cisley, which possesses the property of giving a copy without dampening the paper or the use of a press, is prepared as follows: About sixty grammes of any ordinary ink are placed in a bottle, and half its weight of sugar-candy, and four or five drops of gum arabic dissolved in water, added. A letter written with this ink should be placed under a sheet of copying-paper, and the hands passed over it, when a perfect impression will be obtained in a moment. If the copy do not take well, it is necessary to increase the quantity of sugar, but not of the gum. It is, of course, better to use a regular press, as this gives a more even impression, but the application of the hand or of a paper-folder is sufficient. It is not necessary to moisten the copying-paper, as in the ordinary method. The copy must be made within a short time after the letter or manuscript is written—not to exceed an hour at most.—*Revue Horticole*, *May* 16, 1873, 187.

PHOTOGRAPHIC MULTIPLICATION OF DRAWINGS, ETC.

Benneder states that paper prepared as follows costs but about one sixth as much as the ordinary chloride of silver paper, and is as well adapted to the multiplication of drawings, and is simpler in its manipulation. A solution of bichromate of potash and albumen, or gum, to which carbon, or some pigment of any desired shade, has been added, is brushed, as uniformly as possible, upon well-sized paper, by lamp-light, and the paper dried in the dark. The drawing (or an engraving or wood-cut, etc.), executed on fine transparent paper, is then placed beneath a flat glass upon the prepared paper, and exposed to the light for a length of time dependent upon the intensity of the light. The drawing is removed from the

paper by lamp-light, and after washing the latter with water a negative of the drawing remains, since the portions of the coating acted on by the light become insoluble in water. From such a negative any number of positives can be taken in the same way.—14 *C*, 1874, CCXI., 49.

PREPARATION OF PHOTOGRAPHIC TRACING-PAPER.

A paper sensitive to light, brought into the market by Talbot, of Berlin, under the name of "Lichtpauspapier," by means of which any one unskilled in photography may copy plans, maps, etc., with little trouble, may be perfectly imitated by floating good strong albumenized or arrow-root paper, for about a minute, on a bath composed of water, thirty-two parts; nitrate of silver, three parts; citric acid, one part; and tartaric acid, half a part; then drying it, and finally drawing it slowly through a weak solution of tartaric acid. It will keep at least three months, if protected from light and moisture, and does not require fuming with ammonia. Toning, which is in most cases superfluous, requires a very strong alkaline bath.—5 *C*, 1874, XII., 96.

A VERY SIMPLE PANTOGRAPH.

Schnaus suggests the use of a fine rubber cord, about fifteen inches long, supplied with a loop at each end, and having on it a small white bead, sliding upon it with gentle friction. By securing one end to the table by a pin, and passing a pencil through the other end, and drawing its point over the paper with the right hand, keeping the string stretched, and causing the bead to describe the outline of a simple drawing placed beneath it, a tolerably good copy of the drawing will be produced, bearing any desired proportion to the original, according to the position given to the bead on the string; thus, if the bead is in the centre of the cord, the drawing will be double the size of the original. The best results are only obtainable after some practice, and by employing a finer point than a bead.—5 *C*, 1874, IV., 31.

WATER-PROOF TISSUE-PAPER.

A paper unaffected by water or oily matter, possessing the external appearance of parchment-paper, and suitable for tracing-paper, may be produced, according to R. Jacobsen,

by floating tissue-paper on an aqueous solution of shellac in borax. After drying the paper in the air, it may be smoothed with a warm flat-iron. Very deceptive casings for sausages may be made from brown tissue-paper treated in this way; and, by coloring the shellac solution with aniline, beautifully colored water-proof paper may be producĕd, suitable for artificial flowers.—6 *C*, *October* 16, 1873, 414.

FRICTION SEALING-WAX.

At the Vienna Exposition were shown small sticks of variously colored sealing-wax, tipped with an inflammable compound, which, when ignited by friction, burns and fuses the wax, permitting it to be used very conveniently, without wasting or dropping, as is usually the case. The quantity in each stick is sufficient for one common or two small seals. —8 *C*, *October* 9, 1873, 342.

THE HELIOPICTOR.

The Heliopictor is the name given by Dr. Stein to a simple apparatus devised by him, and intended to expedite the photographic processes necessary in field operations, whether for scientific or artistic purposes, but especially the former. He also thinks his apparatus applicable to the investigations of physicians with the microscope, ophthalmoscope, etc.; he suggests, also, its special application to the observation of the transit of Venus. The apparatus consists essentially of a thin box that can be attached firmly to the eye end of a telescope, and when in that position the front side of this box is composed of a plain glass, the back of which is sensitized for the reception of the image to be photographed. The back of the box is closely sealed, as are also the sides, so that no extraneous light can enter. Between the sensitized plate and the metallic back is a shallow space; sufficient, however, to contain the liquid that would fill the bath in the ordinary photographic dark room. Dr. Stein proposes, after the sensitized plate has been acted on, to pour into this space by a suitable funnel the liquid necessary in order to fix the photographic image; in other words, the box is both camera and dark room combined, all the critical photographic operations being performed without removing the sensitized plate from the box. The compactness of this arrangement evidently

recommends it strongly to travelers, and it has been stated that Dr. Stein's invention will be adopted by the German observers of the transit of Venus.—*Astron. Nachrichten*, LXXXIII., 65.

VANADATE OF AMMONIA FOR THE MANUFACTURE OF INK.

The invariable detection, by Böttger, of vanadium in all specimens of pisolitic limonite (Bohnerze), and the separating it, by his process, in larger quantities than had been obtained before, led him to call attention to the applicability of the neutral vanadate of ammonia in the manufacture of a most excellent, deep-black, very fluid writing-ink. This may be made by triturating three parts of the salt with one part of pyrogallic acid and three parts of finely pulverized gum arabic in a porcelain mortar, with the addition of a suitable amount of cold rain-water. The separation of the vanadium from the iron ore is accomplished by pulverizing it very finely, mixing it with nitrate of potash and caustic soda, and subjecting it to a red heat for a short time in a Hessian crucible; then extracting the mass with boiling water, and carefully adding to the filtered liquid so much nitric acid, free from hyponitric acid, that but a slight alkaline reaction may be retained. Solution of nitrate of baryta is then added to the liquid filtered from the larger part of the silica and alumina of the ore separated in this way, and from the insoluble vanadate of baryta, thus formed, vanadic acid and other vanadates are easily prepared.—15 *C*, 1873, XVIII., 287.

INCREASING THE SENSITIVENESS TO LIGHT OF BROMIDE OF SILVER.

The insensibility of bromide of silver to certain colors of the spectrum has been well established in practice, as also its peculiar sensibility to invisible ultra-violet rays. Vogel has shown that the sensibility of this preparation may be carried far into the red end of the spectrum, to regions where hitherto photography has been impossible. His attention seems first to have been called to this subject by receiving some dry sensitive plates from England, which proved to be more sensitive to the green than to the blue rays; and, in general, he found that the dry bromide exhibited a more extended sensibility for colors than did the so-called wet plate.

This sensitiveness, however, was much affected by the method of development. In attempting to prepare bromide of silver plates with his own hands, he found no repetition of the phenomenon which he had noticed on the English plates; and, reasoning upon the subject, he conjectured that the English plates must contain some substance that absorbs the green rays in a greater measure than the blue. Noticing that the English plates had, among other things, a yellow coloring matter as a coating, he made an attempt to impregnate bromide of silver with a substance that should absorb especially the yellow rays. The substance he chose was coralline dissolved in alcohol. The plates prepared in this way were of a decided red tint, and on exposure to the spectrum they proved specially sensitive in the indigo and in the yellow, and of diminished sensitiveness in the intermediate portions of the spectrum. Thus a method was attained of preparing bromide of silver plates that were acted upon almost as strongly by a color hitherto held to be chemically inert—namely, yellow—as they were by the indigo blue. Proceeding further in his experiments, he found among the green aniline products a body endowed with a powerful absorption of red rays, by means of which he heightened the sensitiveness of his bromide plate to that color. From these results he thinks he is well justified in inferring that we are in a position to render bromide of silver sensitive to any color that we may choose. These experiments, both in a practical and theoretical point of view, cover a somewhat different field from those of Dr. Draper, of New York, who thirty years ago demonstrated that any color whatever could be photographed by employing a properly selected chemical for preparing the sensitive plate.

MECHANICAL PHOTOGRAPHIC PRINTING WITHOUT A PRESS.

The following process, devised by Jacobsen, requires no press, and is adapted to printing on round objects, as vases, bottles, etc., and indeed may, perhaps, be used with colors that are to be burned in. A carbon picture, formed in the usual way on a glass plate, is surrounded by a wooden frame which fits closely to the glass, and into which is poured, when not too warm, a mixture of one part of gelatine, one part of gum arabic, and two parts of glycerine. When this

has stiffened, the frame is removed by the aid of a knife, and the gelatine plate, with the adhering carbon print, is carefully inverted. It is inked with printer's ink previously dissolved in turpentine or benzole (without the addition of any varnish), and distributed by means of a glass roller with a ground surface. A sheet of uncoagulated albumen-paper is then laid upon it, and, after being rubbed gently with a caoutchouc rubber, is drawn from the plate. The paper must not remain too long upon the plate, or it may soil the latter by solution of some of the albumen. It is not necessary to dampen the plate, since it is damp enough to yield several dozen impressions, and when exhausted is so hygroscopic that it will again absorb enough moisture from the air in a few hours.—15 *C*, XXI., 331.

IMPROVEMENT IN THE PREPARATION OF PLASTER CASTS.

An improvement in the preparation of plaster casts of objects of art, etc., has lately been made by Mr. Caussinus, of France, in what he calls the metallization of the plaster. The details of this are at present a secret, although some hints are given by a writer in a French journal. The cast is taken in the ordinary manner, and when removed from the mould is brittle and porous, as usual. It is then soaked in a fluid, which the writer of the article referred to thinks is at the same time both oily and silicious, and which imparts to the cast a coating that enables it to resist a rather violent blow without being injured, giving off at the same time a metallic resonance. The pores of the plaster become filled, and the whole substance is homogeneous and solid as stone. The metallization consists in applying a salt of copper in a semifluid condition, layer after layer being put on, and each polished before the application of the next coating. The total thickness of the application is a fraction of a millimeter, and it adheres with the utmost tenacity to the cast. Some sulphuret is then made to act on this coppery coating, so as to bring about at once the effect of bronze; the form of the sulphuret, whether proto, deuto, or trito, corresponding with the effect desired. The appearance of ivory, granite, porphyry, colored marbles, or any other external condition, can be readily given to the plaster. The result of the operation is said to render the plaster as solid and homogeneous as metal it-

self, so that the object can easily be washed, scrubbed with soap and water, and subjected to various influences without the slightest ill effect. One application of this metallic plaster has been already made, on a large scale, in reproducing coins, medals, etc., in which the physical and external characters of the originals are perfectly imitated. Specimens of the art executed according to Mr. Caussinus's process are to be seen in the peristyle of the first story of the Bank of France, and elsewhere in Paris.—*Jour. Acad. Nat. et Com. de France*, 1873, 491.

A NEW MATERIAL FOR MODELING (PLASTILINE).

A new plastic material for modeling, invented by Giudice, of Genoa, has been adopted for figures and ornaments in the modeling school of Genoa, as well as by many sculptors. It is said not only to remove some of the difficulties of modeling, but to increase the facility of the process. It is lighter than clay, having a specific gravity of 1.39, and does not shrink like it on drying, nor harden like wax, but retains its plasticity and softness at all times. It is insoluble in water, and contains no water, which, by evaporation at ordinary temperatures, might prove injurious to the health. Its great superiority is specially apparent in modeling colossal figures. It is sold of four grades, according to softness, No. 1 being the softest.—9 *C*, *January*, 1874, 4.

TEXTILE INDUSTRY AT THE VIENNA EXPOSITION.

In a report on this subject by Dr. Grothe, we are informed that in the Chinese portion a collection of articles, as brushes, mats, water-proofs, etc., was exhibited, made of the fibres of the so-called "Tucum palm," cultivated in the southern provinces, the wood of which is also manufactured into household utensils. The fibres of the *Borassus gomuti*, a kindred tree, is used for similar purposes by the Malays, and is said to be even better than that of the Tucum. Manini, of Florence, exhibited fibres, and spun and woven articles, indicative of the possible utilization of the inner bark of the *Genista tinctoria*, or Dyer's Broom, which from their quality could only be considered as an attempt to call attention to this plant. Taussig asks consideration for a vegetable growth, much like wadding, that has become quite common in the Banat, Hungary, since

the great floods, and which sunlight bleaches snow-white. Some were disposed at first to regard it as an accumulation of vegetable fibres, collected and felted by the action of water. In the last two years it has become an article of trade in that region, and it is used extensively as a lining for garments of peasants. A material called Pulu was exhibited in the Chinese department, which seemed to surpass in every respect Kapok, the vegetable wool of the *Bombax ceiba*, etc., of Java, introduced by Kratzenstein & Co., of Amsterdam, for stuffing beds, furniture, etc. The Pulu is a gold-brown fibrous material, of silky lustre and exceeding softness and fineness, possessing a very high degree of elasticity for vegetable fibre, and is probably identical with a substance collected very largely in the Sandwich Islands from the tree fern, and exported under the same name. Solinas, of Alexandria, exhibited a collection of fibres prepared from Nile reeds, and isolated so carefully and of such length as to make a favorable impression. A specimen of the *Welwitschia mirabilis*, of Benguela, was shown in the Portuguese department, a plant perhaps never before seen in Europe, and well deserving the name *mirabilis*. Its long leaves are very rich in tough fibres, which could doubtless be utilized.—32 *C*, *Oct.* 18, 1873, 315.

BICHROMATE OF POTASH IN DRESSINGS FOR FABRICS.

Certain thickening materials, as gum, dextrine, and especially glue, when mixed with a very small quantity of bichromate of potash, as is well known, become totally insoluble in water after exposure to diffused as well as direct sunlight—a fact made use of in the carbon-photographic printing process. An equally valuable application consists in the employment of gelatine, with the addition of a small amount of bichromate of potash, for dressing and water-proofing linen, silk, and cotton fabrics. Thus, if the cloth is saturated with a solution of gelatine, to which about one fortieth or one fiftieth of bichromate has been added, and then dried and exposed to the sunlight, the dressing becomes so fixed to the material that scarcely any agent will remove it. In this manner, fabrics, whether of cotton, linen, or silk, may be rendered water-proof, for use as umbrellas, cloaks, etc.; or, if the gelatine mass be thick enough, they will even be rendered impermeable to gases.—14 *C*, 1873, CCIX., 371.

STIFFENING GAUZE.

Good wheat starch and white wax are employed, either cold or warm, according to the color. The gauze, on removal from the starch, is perfectly untwisted, pressed out, and clapped with the hands, so that the starch may be uniformly distributed. Any meshes that may still appear filled with starch may be freed from it when the gauze is stretched on the drying-pad by brushing it with the hand, or, better, with a soft brush. Small starched pieces can also be placed on the finishing-drum, since the starch remaining in any meshes will stick to the drum when the gauze is removed. In this case, however, it will unavoidably have a spotted lustre on the side next the drum.—26 *C*, 1874, I., 5.

PASTE FOR LABELS ON BOTTLES, ETC.

An excellent paste for fixing labels on glass, wood, or paper may be prepared by dissolving eleven parts, by weight, of common glue, soaked a day before in cold water, seven parts of gum arabic, and some rock candy, in fifty-six parts of water, at a gentle heat, with continued stirring until the mass is uniform. Labels brushed with this and dried will adhere firmly if simply moistened with saliva when used.—15 *C*, 1874, IV., 64.

STARCH FOR RENDERING CLOTHING INCOMBUSTIBLE.

The following process for the preparation of starch that will render fabrics incombustible is given by Hagar: Cover 10 parts of white, pulverized bone-ash with 50 parts of hot water, and add gradually 6 parts of sulphuric acid. Stir the mixture thoroughly, and allow it to stand for two days, with occasional stirring, in a warm place. Then add 100 parts of distilled water, filter, and add to the filtrate 5 parts of sulphate of magnesia dissolved in 15 parts of distilled water, and stir in ammonia, while cold, until a perceptible odor is imparted. Press the precipitate formed in a linen cloth, dry it in a moderately warm place, and reduce it to a fine powder. Mix 2 parts of this powder (phosphate of ammonia-magnesia) with 1 part of tungstate of soda, and 6 parts of wheat starch, and sufficient indigo blue to impart a bluish tint. Care must be taken that the materials are perfectly

free from iron, and that no iron is introduced in any way during the operation. For use, the powder is stirred into about double the quantity of cold water, and enough boiling water then added, with continued stirring, to produce a viscous liquid, into which the articles must be dipped.—14 *C*, CCX., 157.

WEATHER-PROOF WASH FOR WOOD.

According to Kuhr, a cheap and convenient reddish-brown coating of ferrocyanide of copper can be formed upon wood, which not only adheres firmly and resists the weather, but also preserves the wood by keeping it free from moss, etc., as well as from injurious insects. To produce this result, wash the surface (previously brushed with a solution of half a pound of yellow prussiate of potash in a gallon of water) with a solution of one pound of blue vitriol in a gallon of water. The shade can be regulated by varying the strength of the solutions. Since the wood is stained rather than covered, its texture remains somewhat visible, which is not objectionable; and by coating it with linseed-oil varnish, not only is its durability increased, but a gloss is imparted, without which it is rather dull.—25 *C*, XXXIX., 318.

PROTECTION OF LEAD WATER-PIPES BY A FILM OF SULPHIDE.

As a result of the following experiments, it is announced that a film of sulphide of lead forms an excellent protection for the metal against the action of water. Lead pipes were coated internally with sulphide, according to the method of Dr. Schwarz, by the action of a solution of sulphide of sodium, and were subjected, at the same time with others not so treated, to the action of rain, snow, distilled and ordinary Paris city water. After the first day lead was detected in all cases in the water from the ordinary pipes, except in the city water, and in it also after several days. On the other hand, in no case did the water from the pipes treated with sulphide afford a trace of lead within three months, and with access of air.—14 *C*, 1874, III., 401.

WATER-PROOFING LINEN.

The following process is recommended by Kuhr for this purpose: Pass the linen first through a bath of one part of

sulphate of alumina in ten parts of water; then through a soap-bath, prepared by boiling one part of light-colored rosin and one of crystallized carbonate of soda with ten parts of water, until the rosin is dissolved, and separating the rosin soap formed by the addition of one third of common salt, and then dissolving it, together with one part of soda soap, by boiling it in thirty parts of water. From this bath pass the articles finally through water, then dry, and calender. Made-up articles may be brushed with the solutions in succession, and be rinsed in the rain. Wooden vessels may be employed.—5 *C*, 1874, XIII., 103.

RENDERING HOSE, FOR FIRE-ENGINES, WATER-TIGHT.

It is claimed that hemp or cotton hose for fire-engines may be rendered water-tight, without injuring the quality or durability, according to a patent of Kremer, of Bavaria, by impregnating the hose, every time after use, with a mixture of one hundred parts of chemically pure glycerine and three parts of crystallized carbolic acid, either by drawing the hose through the liquid, or brushing the liquid upon the hose previously cleansed and dried, and laying it aside in this moist condition. The previous drying, after use, is not, however, absolutely necessary. The effect of the slightly acid liquid on any brass fixtures on the hose is practically unnoticeable, but may be prevented, if desirable, by coating them previously with shellac, varnish, or tallow.—6 *C*, *March* 12, 1874, 108.

BISULPHITE OF SODA FOR COUNTERACTING THE EFFECTS OF CHLORINE IN BLEACHING.

According to Dr. Schuchardt, of Görlitz, the most decidedly injurious effect of hyposulphite of soda as an anti-chlorine, and one not fully recognized by many manufacturers (namely, the deposition of finely divided sulphur in the fabric, liable to be gradually oxidized to sulphurous or sulphuric acid in the air), may be entirely avoided by the use of bisulphite of soda. This is also preferable to sulphite of soda, employed with good effect by some, because an equal weight brings into play a much larger amount of sulphurous acid, and larger amounts of material can therefore be dechlorinated in a given time. Schuchardt is prepared to furnish a pure white, dry salt, containing fifty per cent. sulphurous acid, at a much

cheaper and more economical rate than the hyposulphite or sulphite. The excellent effect of the bisulphite solution, acidified with sulphuric acid, in bleaching and washing wool, is known, and also the beauty and liveliness of the colors afterward taken in dyeing.—15 *C*, 1873, 177.

METHYL VIOLET ON WOOL.

For ten pounds of wool, boil one ounce of methyl violet in a soap-bath, prepared by boiling one quarter of a pound of washing soap, and dye the articles at 158°. To produce a bluer shade, first dye in a bath of methyl violet alone, at 140° to 158°, and then boil for a quarter of an hour in a soap-bath of a quarter of a pound of soap. The wool, however, in this case must be dyed a few shades darker, since the soap-bath renders the color lighter. The color obtained in this way is a tolerably pure and very lively blue. A desired shade may also be produced by boiling the wool for half an hour in a bath of three pounds of Glauber's salt, a quarter of a pound of sulphuric acid, and one ounce of methyl violet.—26 *C*, 1874, I., 2.

EXTRACT OF SUMAC.

According to Reimann's *Färber-Zeitung*, extract of sumac, obtained by boiling and evaporating in a vacuum, has recently been brought into commerce in the form of a thick sirup, which is without any trace of acidity, and which will keep indefinitely; while the common decoction of sumac soon turns sour and becomes useless. The chief advantage in the use of the extract lies in the economy of time and room, since it simply requires dilution with hot water. The weight of extract, for any shade, can also be accurately determined, and it can be conveniently employed in many cases to produce a desired shade by subsequent additions to the bath, and may often be found of value in dyeing, although possibly too expensive for general use.—14 *C*, 1873, CCX., 316.

BARYTA GREEN, OR MANGANATE OF BARYTA.

Experiments were made by Fleischer to discover a more direct method for the preparation of the pigment—manganate of baryta, or baryta green—of greater purity and beauty than that introduced into the market under the name of Rosen-

stiels or Cassel green. As a result, he recommends a different method, and calls attention to a superior blue-green manganate. In regard to the two methods of preparation already published, he states that the one by fusion of caustic baryta with pyrolusite and chlorate of potash affords a more beautiful and homogeneous product than that by ignition of nitrate of baryta with sesqui-oxide or bin-oxide of manganese; and also that the color by the latter is by no means as permanent, on account of the reducing action, in time, of traces of nitrous acid remaining. He found, however, a better method, in the addition of chloride of barium to a green boiling solution of manganate of potash, by which a heavy, granular, though not crystalline precipitate is formed of a violet—almost blue—color, which can be tolerably well washed by decantation, and finally be easily drained on a filter. This loses color, on drying, by gradually increasing the temperature, until, at the lowest red-heat, it appears nearly white, with a trace of grayish-blue. By heating it higher, with access of air, or in an oxidizing flame, it gradually becomes perfectly green, and by heating still further passes to a beautiful green-blue, until finally, at a high temperature, it forms a dirty, grayish-brown mass by reduction of the manganic acid. With a solution of permanganate of potash, chloride of barium affords, after continued boiling, a peach-blossom colored precipitate, while the liquid retains an intense violet color. This precipitate of permanganate of baryta can be washed by decantation, and dried at 212°, without changing color. With a gradual elevation of the temperature, however, it loses color, but, unlike the manganate, does not afford either a blue or green compound by simply heating with access of air; on the contrary, it rapidly passes into the grayish-brown compound before mentioned; so that the permanganate, under these conditions, is not adapted to the preparation of baryta green. While the pigment produced by ignition of the manganate surpasses in beauty that produced by the other two methods, and although it might be possible to improve that produced from the nitrate of baryta by manufacturing it in a reverberatory furnace under a strong oxidizing flame, in no case is the green equal in beauty to the blue-green—almost azure-blue—compound, of which no public notice has been taken. This pigment has different shades, according to

the mode of preparation; some being almost pure blue, with a slight tinge of green, and resembling the light-blue color of the wing feathers of some parrots. Deepening the shade of green in the pigment strengthens the color, but to the same degree impairs its fineness, although it will still surpass in beauty the pure green manganate. The formation of the blue-green compound depends entirely on the alkalinity of the mass, but it is doubtful whether a definite composition corresponds to each color, as the temperature (which should never exceed a bright-red heat) has greatly influenced the color. It is at least certain that the manganate, as well as permanganate of baryta, mixed with about twenty per cent. of hydrate of baryta, will always yield the blue-green pigment on ignition. The blue-green color depends entirely upon its basic character; since it first turns green, and is then gradually decomposed, when the powder is placed in weak acids. Baryta pigments are otherwise quite permanent; tolerably strong sulphuric acid does not affect them for hours, at ordinary temperatures, and boiling potash has practically no effect on the green. In any case, the permanence of the blue color is increased by the addition of a little baryta. These pigments seem particularly adapted to fresco-painting, as they appear most brilliant on stone, and especially on lime; but their preparation is rather expensive.—15 *C*, 1873, xxiv., 371.

ALIZARINE RED ON COTTON.

Although the new alizarine red had been used to a considerable extent in dyeing turkey-red, and produces a more beautiful color than madder, its general introduction could not be predicted, since it is more expensive than madder. The discovery of a shorter and cheaper method of producing this pure and beautiful color is claimed by Geyer, by which the operation is completed in about one third the time, at twenty per cent. less cost than the ordinary turkey-red, and without any sacrifice of purity or beauty.—26 *C*, 1874, I., 3.

BASTAERT'S PROCESS FOR DRYING ALL KINDS OF FABRICS.

The following process is said to be applicable to heavy or light goods of cotton, linen, wool, or silk, bleached or unbleached, printed or dyed. On account of the uniformity of

its action, it imparts to the goods, without any harshness in feeling, a finer finish than any other method. With all this advantage, it consumes a minimum of fuel, demands little room, does not require a special boiler, and is exceedingly simple. In the operation, steam is passed from a boiler under a pressure of three to six atmospheres, and is superheated, without increasing its pressure, by passing through heated tubes. It finally issues in a number of small jets, uniformly distributed along a tube, so near to each other that a sheet of dry steam, as it were, is formed, which, with the air drawn along and heated by it, impinges, by a simple, suitable construction of the box surrounding the jets, upon the cloth moved in front of it. The distance of the cloth from the jets is adjustable for different fabrics, and plans are also given for arranging several sheets of steam to play on the cloth in succession, or on both sides at the same time. The pressure, amounts of steam and air, temperature, etc., can be regulated to suit different cases. The steam, issuing under pressure, seems to act in part by penetrating the material.—14 *C*, CCIX., 173.

COCHINEAL RED ON WOOL.

Boil the wool for an hour in a bath prepared in a copper (or better, a tin) vessel, with soft water, with the addition of half a pound of oxalic acid, half a pound of tin salt, and one pound of cochineal, for ten pounds of stuff. The bath may be repeatedly used, after clearing it, and the proportions given may be varied, when an economical effect of the cochineal will be apparent. It is suggested by Geyer that the addition of yellow would render the color more fiery, without adding practically to the cost.—26 *C*, 1874, I., 2.

BEAUTIFUL WHITE FOR WOOL.

According to the *Deutsche Wollen-Gewerbe Organ*, a beautiful white may be imparted to wool by working it about an hour in a bath, at 122°, composed, for 50 pounds of wool, of alum, 2 pounds; tartar, ⅔ of a pound; sulphuric acid, 1 pound; soluble indigo, 3 ounces; archil, 1½ ounces (or iodine violet, soluble in water, 28 grains), and afterward allowing it to lie for about two hours in a solution of 1 pound of chloride of barium in water at 122°. There is also a gain in weight of

about 18 per cent. by the precipitation of sulphate of baryta (permanent white) in the fibres of the wool in the second bath.—23 *C*, *November* 1, 1873, 419.

ANILINE GREEN ON WOOL.

According to Lauth, the wool is first to be prepared in a bath to which hyposulphite of soda and an acid, or an acid salt, has been added; the sulphur precipitated on the wool in this way fitting it to take the aniline color. A tendency of the wool to lose its elasticity, and to become soft and shrink, on account of the penetration of the sulphur into the fibres, may be remedied by adding a small quantity of alum or of zinc salt to the bath. Before treatment with the hyposulphite, the wool must be scoured and freed (by means of dilute hydrochloric acid) from any metallic compounds that may have been taken up in spinning or weaving, otherwise brown specks of metallic sulphides may be formed. The dyeing is accomplished by simply placing it, when well washed, in a solution of aniline green in warm water and gradually raising the temperature to 212°.—6 *C*, *October* 9, 1873, 406.

ECONOMICAL INDIGO COLD-VAT.

A considerable economy of indigo may be effected, according to Reimann's *Färber-Zeitung*, by forming the cold-vat by boiling four pounds of red saunders-wood and eight pounds of catechu with about ten gallons of water, and dissolving two pounds of salt in the liquid. This is to be strained after boiling again, and the clear decoction then poured into the vat, into which, after it is filled sufficiently with water, the indigo preparation is to be introduced. This is composed of twenty-four pounds of sulphate of iron, sixteen pounds of lime, and six pounds of indigo, to be well stirred before allowing it to settle for use.—24 *C*, 1873, XXXVII., 292.

DYEING ORNAMENTAL FEATHERS BLACK.

Place them for twenty-four hours in a soda-bath that is not too strong, then rinse well, and place for twelve hours in an eight per cent. solution of nitrate of iron; rinse well again, and dye with logwood and fustic. If the black appear reddish, draw the feathers through dilute sulphuric acid, and boil a short time in a weak bath of fustic.—26 *C*, 1874, I., 4.

NAPHTHYLAMINE COLORS FOR PRINTING ON FABRICS.

A mixture having the properties of aniline black, which is said to produce fast colors, and is adapted to printing on fabrics, may be obtained by adding an oxidizing agent, as chlorate of potash, a copper salt, or hydrofluosilicic acid to a naphthylamine salt, such as the nitrate, acetate, or chloride. The fabric printed with it must be exposed to the air for some time, then be passed through a bath of bichromate of potash, to which sulphuric or nitric acid has been added, and finally, if a beautiful brown or brownish-violet is desired, must be dipped in a solution of an alkaline chloride. The colors produced are said to be permanent.—5 *C*, 1873, XLII., 330.

CHOCOLATE COLOR ON WOOLEN GARMENTS.

Boil ten pounds of the goods, for an hour, with one half of a pound of alum, one half of a pound of tartar, and five ounces of chromate of potash; allow them to cool in the bath, and dye by boiling, for half an hour, in a fresh bath of fustic, Brazil-wood, and logwood, according to the shade desired.—24 *C*, 1874, X., 73.

DARK GREEN ON HALF-WOOL GARMENTS.

For a garment of two pounds, dye the wool by boiling with one half of a pound of alum, and as much indigo-carmine and fustic decoction as may be needed; then rinse, and gall overnight with one half of a pound of sumac, and finish dyeing in a fresh bath, with addition of solution of methyl green. If the shade is not yellow enough, use a little fustic or quercitron in the green bath.—24 *C*, 1874, X., 73.

ANILINE BLUE ON WOOL.

Add to the water in the kettle half a pound of solid chloride of tin, and carefully remove the scum that forms; then, for 20 pounds of cloth or yarn, add 2 pounds of sulphuric acid, 1 pound of sulphate of alumina, and another ½ pound of chloride of tin, and work the goods in this bath a quarter of an hour at boiling temperature; then add to the boiling bath 3 to 4 ounces of aniline blue, soluble in alcohol, in solution, prepared by carefully bringing to boiling heat 1

part of it in 20 parts of strong alcohol, or in 10 parts of alcohol and 10 of acetic acid, and continue boiling with constant stirring for a quarter of an hour, then diluting with water, and passing through a hair sieve (or, instead of this solution, aniline blue soluble in water would be better). For greater certainty, it is best to add the alcoholic solution of aniline blue, or the proper quantity of that soluble in water, in two portions, and to work the goods in the boiling bath for half an hour after each addition. The color is finally improved and preserved from rubbing off by passing the goods through a cold soap or bran bath.—23 *C*, *March* 16, 1874, 109.

YELLOW ON SILK GARMENTS.

Boil the articles, for half an hour, in Marseilles soap, with the addition of wheat bran; then rinse, and dye to a buff in a bath of soap and annatto, lift, and pass through a sulphuric-acid bath of $\frac{1}{4}°$ Beaumé, in which they will acquire a beautiful yellow color.—24 *C*, 1874, x., 73.

VIOLET OIL-PIGMENT FOR PRINTING ON FABRICS.

Pour alcoholic solution of violet aniline B. B. upon finely powdered chalk in a saucer, stir well with a rod, and allow it to dry on a hot plate or in the stove; then stir to a powder, and again simply moisten it with the aniline solution; dry again, pulverize, and preserve in a dry place. For use, rub some with zinc-white, according to the shade desired. The pigment is rich, and prints well, but is not permanent in the air with ordinary usage, and the best B. B. must therefore be employed, of a greenish cast, like diamond fuchsine. With this the oil color wears as well as much more expensive ones.—26 *C*, 1874, vi., 54.

A FAST AND EASILY PREPARED BLACK.

Place the cleaned and washed goods overnight in a cold bath of $1\frac{1}{4}$ pounds of sulphate of iron for five pounds of half-wool goods; drain them off well from this, and work a quarter of an hour in a fresh bath with two ounces of chromate of potash, and rinse well in running water. Then boil for some time, until the bath is spent, in a kettle in which half a pound of sumac and two pounds of logwood have been boiled in a bag, removing the bag if the room is needed, and rinse

well on removal from this. A brownish (over-dyed) shade may be imparted by passing the goods through weak sumac and sulphate of iron.—25 *C*, 1874, XI., 86.

SCARLET ON HALF-WOOL GARMENTS.

Boil ten pounds of thoroughly cleansed goods, for half an hour, with one half of a pound of oxalic acid, one quarter of a pound of tin salt, one pound of turmeric, and one pound of cochineal; then rinse, place six hours in a bath of one quarter of a pound of tannin, reel off, and finish dyeing in a cold fuchsine-bath.—24 *C*, 1874, x., 73.

CŒRULIGNON, FROM WOOD-TAR, FOR PRINTING FABRICS.

Although no method for the utilization of wood-tar is likely to prove of as much practical importance as the discoveries in coal-tar, on account of the comparatively limited quantity of the former produced, experiments have recently been conducted with this in view. Attention was first directed, some years ago, by Reichenbach, to a red crystalline precipitate, obtained by treating beech-wood tar with bichromate of potash and tartaric acid, or a solution of sesquisulphate of iron, and named by him cedriret, which afforded an indigo-blue solution with concentrated sulphuric acid, and a purple one with creosote. More exact recent investigations by Professor Liebermann have led to the production of several new compounds from wood-tar, one of reddish-blue color being named Cœrulignon, on account of the blue solution it affords with sulphuric acid. Further experiments by C. Fischer led to a very simple process for printing a lively orange on silk or wool, by dissolving this substance in hot alcohol, and precipitating it again with water, then thickening the paste with gum-water of the proper consistency, and printing, drying, and steaming the fabric. In steaming, the slight color of the printed portions disappears, and after washing out the thickening a lively orange may be developed on them by treating the goods in a bath of bichromate of potash or of sesqui-chloride of iron. They may then be washed and finished. Attempts to print with it on cotton have not thus far proved successful. Experiments on a large scale are of course necessary to determine the practical value of the method.—8 *C*, *April* 2, 1874, 117.

METHOD OF COLORING VENEERS.

A method of preparing veneers, in which the color saturates the entire mass, and of course is exhibited even when the surface is abraded, consists in first soaking them for twenty-four hours in a solution of caustic soda, and then boiling them in it for half an hour. They are then washed with water until all the alkali is removed, when they are ready to receive the dye. This treatment with soda effects a general disintegration of the wood, so that, when moist, it is elastic and leather-like, and is prepared to absorb the color. Veneers thus treated, if left for twenty-four hours in a hot decoction of logwood, and, after superficial dyeing, immersed for twenty-four hours in a hot solution of copperas, become of a beautiful and permanent black throughout. A solution of picric acid in water, with the addition of ammonia, gives a yellow color, not in the least affected by subsequent varnishing. Coralline, dissolved in hot water, to which a little caustic soda and one fifth its volume of soluble glass have been added, produces rose color of different shades, dependent on the amount of coralline taken. After dyeing, they are dried between sheets of paper, and subjected to pressure to retain their shape.—17 *A*, *April* 1, 1874, 59.

GALENITE, A NEW MATERIAL IN PAINTING.

The Abbé Moigno, in *Les Mondes*, calls attention to a chemical product, called Galenite, which he considers likely to replace to advantage both red and white lead in the arts. The substance is manufactured from galena, a sulphuret of lead, and can be produced in large quantity at a low price—according to the inventor, at from 25 to 30 per cent. less than the substances just mentioned. Galenite, as described by Moigno, is of a grayish-yellow color, and of a density about equal to white-lead; but has the special property of readily uniting in small quantity with pure or non-litharged linseed-oil to form an extremely fat and drying paste, which, when diluted subsequently with oil, may be applied like white-lead to surfaces of plaster or wood, or like red-lead to iron and other metals, possessing great advantages, however, over these substances, both in covering power and solidity as well as in cheapness.

Galenite mixes readily with all ochres, and consequently can be substituted for white-lead in painting in colors. With oil it forms a mastic which can be employed without the use of any other agent in cementing the joints of machines for resisting the greatest pressure of air in water. It preserves metals from oxidation with more energy than red-lead, and may be employed equally with the latter in painting large surfaces of metal. United with carbonate of lime and oil, it forms mastics which, when spread over plaster with the knife, acquire great hardness, and after being sand-papered assume the smoothness and polish of marble. The Abbé also claims that the results of experiments give promise that it will be especially serviceable in painting such portions of the wood or metal surface of vessels as are submerged in water, adhering to them with great tenacity, and probably preventing the adhesion of barnacles, oysters, etc., or the attacks of the teredo. The precise method of manufacturing this new and important substance is not stated. It has, however, been lately patented by its inventor, M. Jules David.—3 *B*, *June* 25, 1874, 284.

VARNISH FOR ALCOHOL CASKS.

Varnishing the interior of clean, dry casks with the following preparation is said to close the crevices and pores of the wood, and to render them perfectly tight for alcohol, as the material oxidizes soon after drying, and becomes insoluble in alcohol, and does not scale off: Dissolve two pounds of leather clippings (best, finely chipped, and previously boiled in water) in two ounces of oxalic acid and four pounds of water, on a water-bath, with continued stirring, care being taken not to prolong the operation more than necessary, and dilute the solution gradually with six pounds of warm water. —9 *C*, *February*, 1874, 28.

VARNISH AFFORDING A DEAD SURFACE ON DRYING.

Varnishes that leave a dead surface on drying, capable of substitution for ground glass, as for glass stereographs, and of use in retouching negatives, may be made by mixing solutions of resins with liquids in which they are insoluble. A solution of sandarach resin in ether, when mixed with one fourth as much benzole, affords an excellent imitation of

gronnd glass; one of dammar resin in benzole, when mixed with ether, also gives a good dead surface; water, instead of the ether, renders it, at the same time, semi-opaque. A mixture of benzole with common negative varnish frequently, but not always, gives a beautiful dead surface. In all cases a great deal depends on the purity of the ingredients. It is recommended to dissolve from 3 to 15 parts of sandarach in 48 parts of ether, and to add 24 parts of benzole, or as much as may be necessary to produce the desired result. The following, by Hughes, is said to give a perfectly colorless varnish of this kind: Ether, 560 grains; benzole, 240; sandarach, 40; Canada balsam, 10. The resins are first to be dissolved in the ether, and the benzole added to the solution.—5 *C*, 1873, XLV., 350.

ROSE-COLORED STAIN FOR WOOD.

Monnier recommends steeping the wood for several hours in a bath of 1200 grains of iodide of potassium to the quart of water, and then immersing it in a bath of 375 grains of corrosive sublimate, when it will assume a beautiful rose-red color by chemical precipitation. It should subsequently be covered with a glossy varnish. The baths will not need renewal for a long time.

ELECTRO-STANNUS.

Several years ago a patent was taken out in London in regard to a process called electro-stannus, which is in reality a method of coating with tin objects intended for subsequent plating with silver, so as to give a body, and reduce the amount of silver necessary to cover the original material. This is applicable to all kinds of iron substances, and has lately received an extended application. The principal difficulty has been to keep the tin of the electric floating bath in solution, as it has a tendency to fall to the bottom in the form of a precipitate. To prevent this, grain tin is dissolved in nitro-muriatic acid, or in nitric acid, and thus a solution of nitro-muriate, or of nitrate of tin, is obtained. To this is added a solution of cyanide of potassium and water, the quantity used being sufficient to precipitate the tin contained in the nitro-muriate or nitrate solution. The oxide of tin thus obtained is washed with water in a filter, and either

drained or evaporated to dryness, or used when of a pasty consistency. This oxide is then put into an earthenware pan, and as much sulphuric or muriatic acid, or sulphuric and nitric acid, is added as will take up the oxide and hold the tin in solution. A mixture of two parts of muriatic acid to one part of sulphuric acid seems to give the best result. This solution of tin is put into the vat in which the articles to be coated or plated are immersed, and as much soft water added as will make a bath of the strength ordinarily used in electroplating. This is now ready for use.

In addition to the use of this process for coating new metallic objects, it has lately been extensively employed in renovating worn and tarnished articles, experiments upon some that have been completely eaten into by rust showing that they can be so coated as to have the appearance of frosted silver. To accomplish this result, if the articles are of iron and very rusty, they are first placed in a bath of diluted sulphuric acid, after which they are immersed in a bath of potash and water made hot, which removes all the grease. They are then removed to the plating vats, which are of novel construction. At the end of the vat is a plate of metal in connection with one of the poles of a galvanic battery, while over it are metal bars in connection with an opposite pole. The articles intended for plating are then hung in the solution from the bars by means of copper wire, when galvanic action takes place, and they remain more or less time, according to thickness of the plating required. When withdrawn from the vat, the articles are of a dull, whitish color, and need to be subjected to the action of a metallic brush, moistened with a cleansing solution, if the dull appearance be not desirable. The articles thus treated have the appearance of silver, with almost the cheapness of tin.—3 *A*, *April* 25, 1874, 523.

MALLEABLE BRASS.

An alloy may be prepared as follows, which resembles red brass in color, and which may be hammered into any shape when first prepared, while warm, without splitting or cracking, but which when rapidly cooled, and again heated to redness, is brittle under the hammer, but recovers its malleability if gradually cooled. First fuse 33 parts of copper in a loosely

covered crucible, then add 25 parts of Silesian zinc, purified by sulphur; mix thoroughly by stirring, and pour into sand moulds.—34 *C*, 1874, VII., 53.

TINNING IRON WIRE.

Dr. Heeren recommends the following process as rendering iron wire silvery white, and as adapted to wire already in spirals and other forms of iron, and therefore preferable to tinning by the aid of heat: First dip the wire in hydrochloric acid with a piece of zinc in it, and then place it, for about two hours, attached to a zinc plate, in a bath of two parts of tartaric acid dissolved in 100 parts of water, with the addition of three parts of tin salt and three parts of carbonate of soda. On removal from this bath it must be brightened by polishing or drawing.—6 *C*, *May* 7, 1874, 188.

JAPANESE BRONZE.

Curious ornamental bronzes are produced in Japan, which much resemble slate when in thin plates, and these are covered with elaborate designs in silver possessing a bright polish, giving to the work a very striking and elegant appearance. This alloy has recently been examined by M. Morin, who finds that it contains, in addition to copper, from four to five per cent. of tin, and, on an average, ten per cent. of lead. This combination is easily moulded into thin plates, which are varnished, and through this covering the designs are then scratched with a suitable instrument. The plate thus prepared is then plunged into a silver-bath, when the silver is gradually deposited on the unprotected portions. Finally, it is placed in a muffle furnace, where the copper is blackened by oxidation, while the silver retains its brightness.

ALLOY RESEMBLING STEEL.

An alloy, with the properties of steel, may be formed, according to a French patent, by fusing together iron, tungsten, and nickel, in a crucible, by the aid of a flux prepared by melting together 36 parts of boracic acid, 32 of calcined quartz, and 32 of carbonate of lime. For the first quality of alloy, 93 per cent. of soft iron, 6½ of tungsten, and ½ of nickel are employed; for the second quality, 95 per cent. of soft iron, 4½ of tungsten, and ½ of nickel; for the third quality, 97

per cent. of soft iron, 2½ of tungsten, and ½ of nickel.—8 *C*, *December* 25, 1874, 436.

ALLOY RESEMBLING SILVER.

An alloy, said to resemble silver, is prepared, by Pirsch-Baudoin, of Paris, from 71 per cent. of copper, 1.65 of nickel, 1.75 of cobalt, 2.5 of tin, 1.25 of iron, and 7 of zinc. Some aluminium (about 1½ per cent.) may also be added. The nickel is first melted with an equal amount of copper, and the zinc in the proportion of 6 parts of zinc to 10 of copper. The iron, the rest of the copper, and the cobalt (in the form of oxide) are then fused at a high temperature, in a graphite crucible, with the first alloy and charcoal, under a cover of charcoal. To this the zinc, alloyed with copper, is added when the temperature has fallen to a point at which it will simply melt. The crucible is then removed from the fire, and the contents are stirred with a wooden rod, and the tin wrapped in paper added, and the mass stirred again and poured out. Most of the zinc volatilizes in the operation.—6 *C*, *February* 22, 1874, 352.

GLAZE FOR EARTHENWARE.

The glaze prepared by the following process, by Constantin, is said not to be perceptibly affected in 48 hours either by cold or hot vinegar containing 8 per cent. of acetic acid, while it has been found in practice to be about 12 per cent. cheaper than the ordinary lead-glaze: 25 parts of red-lead and 10 parts of finely pulverized quartz are carefully stirred into a 50 per cent. solution of soda water-glass. It is laid on with a brush, either once or twice, with an interval of 12 hours, and is burned as usual.—6 *C*, *May* 7, 1874, 188.

NEW PROCESS FOR NICKEL PLATING.

Martin and Delamotte use organic acids with the salts of nickel, instead of the mineral acids usually employed. The bath is prepared by dissolving 3858 grains of citric acid, 1543 grains of sal ammoniac (or sulphate of ammonia), and 1543 grains of nitrate of ammonia in 6.3 pints of water, heating the solution to 176°, gradually saturating it with freshly precipitated hydrated oxide of nickel, and then allowing it to cool. One pint of ammonia is next added, and the whole di-

luted with water to 10.5 pints. Into this solution (which contains about 385 grains of nickel to the pint), when cold, 1543 grains of carbonate of ammonia are introduced, and the liquid filtered after settling. The liquid is deep blue, and of about 11° Baumé, and, under the influence of the current, readily affords a compact, brilliant, white deposit of nickel. The temperature of the bath during use must be retained at about 122°. Addition of caustic potash or soda renders heavier deposits possible.—15 *C*, 1873, XXIV., 384.

RESTORING BURNED STEEL.

Mr. J. L. Davis announces to the London *Iron* what he calls a simple and efficacious plan of restoring to steel which has once been burned its usual valuable qualities, claiming that this can be accomplished by the use of a fluid which leaves scarcely any thing to be desired on the score of cheapness. The process consists in the use of a resin oil, with which is intimately mixed about one fourth of its weight of the residue of paraffine stills. Chisels that have become useless may thus be restored and made as valuable as ever. The burned steel must be heated red-hot, then plunged into the liquid for a few seconds, then reheated and cooled in the ordinary way, when the steel is said to be perfectly restored. —3 *A*, *May* 30, 1873, 677.

VERY ADHESIVE MUCILAGE, OR VEGETABLE GLUE.

The addition of a solution of 30 grains of crystallized sulphate of alumina, in 300 grains of water, to a solution of 1050 grains of gum arabic, in 2625 grains of water, affords a mucilage that will fasten lightly sized paper, printing-paper, etc., or wood to wood, paper to metal, etc.—13 *C*, *July* 1, 1874, 858.

TEMPERING STEEL.

It is not generally known that steel can be made so hard that it will pierce any substance but a diamond. Many jewelers and lapidaries experience great difficulty in getting the points of their drills hard enough to pierce an amethyst. For their benefit, as well as for that of miners and others using drills requiring a very hard point, the following method of treatment is recommended: The drills should be held, if

small, by hot pincers or tongs while heating. The tool should first be heated to a white heat, and then pressed into a stick of sealing-wax, left there for a second, removed, and inserted into the wax in another place. This operation should be repeated until the instrument is too cool to enter the wax.

USE OF CARBOLIC ACID IN THE TRANSPORTATION OF HIDES AND BONES.

Immersing hides twenty-four hours in a two per cent. solution of carbolic acid, and then simply drying them, has been recently substituted for the tedious and expensive process of salting them for transportation from South America and Australia, and with most satisfactory results. Bones have been similarly treated for transportation.—13 *C, Feb.* 15, 1874, 271.

NEW METHOD OF TREATING HAIR, FUR, ETC.

Reference has already been made to a method of utilizing feathers of barn-yard poultry, wild fowls, etc., in the preparation of a loose fibre to be worked up into a felt cloth, blankets, etc. The following describes a somewhat cognate industry having reference to a new mode of treating fur. This forms the subject of a communication by Mr. Joseph Tussaud, who is at present one of the proprietors of the celebrated wax-work establishment in Baker Street, London, founded by Madame Tussaud. The attention of Mr. Tussaud was first called to the subject by his desire to transfer the hairs of fur-bearing or other animals to wax figures without including the skin in which they were inserted. After numerous experiments he succeeded in accomplishing this, and in developing, as already remarked, a new industry.

The great object which Mr. Tussaud aimed to secure was the removal of hair or fur from the skin, and then attaching this to an artificial skin, obtaining thus a more perfect degree of preservation for any purpose whatever, while retaining the hairs in their original and natural relationship. For this purpose the piece of fur to be treated may be soaked in lime-water or other suitable liquid, as practiced by tanners, for the purpose of loosening the adhesion of the hairs. It is then to be washed in water, to free it from the superabundant lime or other substance, and hung up for a time to dry off the excess of moisture. It is next laid on a board, with the hair

side up, and a solution of glue applied by means of a brush or otherwise, taking care not to disturb the natural position and relation of the hair. The size or glue is then allowed to harden, when it will hold the fibres very firmly. The natural skin may then be pulled entirely off from the hairs, leaving their ends exposed, which may then be washed by some substance to free them entirely from adherent fat, bulbs, etc., and properly poisoned.

An artificial skin is next to be affixed by applying India rubber, gutta percha, boiled drying oils, or other water-proof substance, over the roots of the hairs, and allowed to dry, so as to form a continuous membrane; after which, all that is necessary is again to soak this in warm water for a time to dissolve out all the glue, and the new fabric is produced in all its completed condition. To render the rubber or gutta percha more lasting, it may be combined with sulphur, so as to vulcanize it, for which purpose a solution of chloride or hypochloride of sulphur in bisulphuret of carbon may be employed. In using bisulphuret of carbon, forty parts of the same are to be added to one part of chloride or hypochloride of sulphur, prepared as neutral as possible, and the solution is then allowed to remain in contact with the artificial skin of rubber or gutta percha a longer or a shorter time, a minute being sufficient for a thin sheet. This operation must be completed, of course, before immersing in warm water, to remove the glue which produces the adhesion of the hairs.

One great advantage of this process consists in the fact that fabrics thus prepared are moth-proof; and it is suggested that for many purposes, such as the construction of rugs, mats, etc., they must be superior to the natural skin. In the case of heavy skins, the artificial preparation is much lighter, more pliable, and better in every respect. Several of these artificial skins may be combined so as to form one, or they may be modified in any manner desirable. When properly made, the preparation is entirely free from any smell, and especially the animal odor which is so offensive in many furs. —23 *A*, *May* 29, 1874, 673.

IMPROVED FORM OF RUBBER.

A recent improvement has been made in the manufacture of articles of India rubber which are liable to be exposed to

considerable heat, such as the valves and packing for steam-engines, washers for pipe-joints, etc. This consists in mixing the rubber or its compounds with carbon, in the form of lamp-black, soot, or ground charcoal, in the proportion of four parts of carbon to one of rubber, the proportions varying with the nature of the article to be manufactured, and with the quality of the rubber; the better this is, the greater being the quantity of carbon that may be mixed with it. For water-proofing fabrics, such as tarpaulins for covering wagons, three to four parts of carbon to one of rubber will be found most suitable; while as packing for steam-engines and pipes, where great heat is to be resisted, from five to six parts of carbon to one of rubber will yield a compound best adapted to the purpose. The mixture of the two is accomplished by the employment of rollers provided with spiral cutters, into and between which the rubber is fed by a hopper, which also supplies the carbon during the process, the rollers being very powerful and fixed in strong bearings. The process requires that the rollers be heated by steam, and that the temperature be maintained at about 250° Fahr. The rubber will be thus cut, torn, and masticated in combination with the dry carbon, and discharged from the delivering end of the machine in a hot, plastic, homogeneous mass, whence it may be reconveyed to the feeding end for a second and more complete treatment if necessary. It may then be applied directly to the surface of a textile fabric, without the use of any additional expensive material, by the agency of heated rollers, which cause the mixture to be incorporated in the interstices of the fabric. If, however, the object be to secure a coating only, a compound of rubber is first applied, and upon this the carbon mixture is rolled.

The great advantage of using cloth treated with this rubber for washers and steam machinery is its complete resistance to heat. Ordinary rubber flanges thus exposed become hardened into vulcanite, and rapidly lose all their value. Tarpaulins and water-proof sheets remain durable and pliant, neither cracking nor hardening in cold, nor being injuriously affected by heat. The inventor is the same Mr. Mackintosh whose name is so familiar in connection with water-proofing compounds.—18 *A*, *April* 24, 1874, 140.

IMPROVEMENT IN THE MANUFACTURE OF STEARIC ACID.

A recent improvement in the manufacture of stearic acid involves the employment of carbon disulphide to increase the fluidity of oleic acid, and thus obviate the use of the hot press. According to the specification, the carbon disulphide may be added either before or after the cold pressing. The crude fatty acids are melted in a suitable apparatus, and mixed while fluid with twenty per cent. of the disulphide, then allowed to cool, and expressed cold. The claim is made for this process that the stearic acid obtained by it is free from oleic acid. Inasmuch as by the old process, with the hot press, much of the solid acid is lost by being pressed out with the oil, the above may prove to be a valuable improvement.

IMPROVED PROCESS OF MAKING ALKALI.

The usual method of manufacturing alkali by what is called the Leblanc process consists in decomposing common salt with sulphuric acid, roasting the resulting sulphate of soda, technically known as salt-cake, with an admixture of ground coke and limestone, and subjecting the crude mass thus obtained to certain refining operations. It is now stated, on the authority of Rudolph Wagner, that an entirely new method has been elaborated, verified, and is about to be introduced on a large scale simultaneously in England, Austria, and Germany. Common salt in solution is mixed with bicarbonate of ammonia; the result is bicarbonate of soda (which crystallizes out), and chloride of ammonium (sal ammoniac), which remains in solution. The latter liquid is distilled along with limestone, the result being carbonate of ammonia, which is collected, and chloride of calcium, which remains in solution. Meantime the bicarbonate of soda, or such part of it as is not required to be sold as such, is furnaced, and thus converted into dry carbonate of soda, or soda-ash. In this operation it loses half its carbonic acid, which, being led into the carbonate of ammonia, is ready to use along with a fresh lot of salt. The only materials thus consumed will be common salt and chalk, or limestone, and the only refuse yielded will be chloride of calcium, which is not incapable of being utilized. The stock of bicarbonate of ammo-

nia will circulate with a waste, which, in case of careful working, will be inconsiderable.

The soda-ash produced will be very strong and pure, free from alkaline sulphates, sulphites, sulphides, and hyposulphites, as well as from a variety of other foreign matters now rarely absent. Soda-crystals will be made, as at present, by dissolving soda-ash in water, and allowing it to crystallize at the proper degree of concentration and of temperature. Caustic soda, now prepared from certain residual liquors, technically known as "red liquor," will have to be again made on the primitive method of treating solutions of carbonate of soda with slaked lime. The nuisances of hydrochloric, sulphuric, and arsenical fumes will cease. "Vat-waste" will no longer be formed, and the ingenious process of obtaining from it hyposulphite of soda, and for recovering the sulphur it contains, will come to an end.

The new process, according to *Iron*, is likely to involve a heavy fall in the price of sulphur and sulphur ores, such as iron pyrites, some of which, especially such as are poor in sulphur or rich in arsenic, may possibly become unsalable. The supply of sulphuric acid will probably be diminished, and the price increased. Hydrochloric acid, now a waste, and difficult to get rid of, will be utilized, and probably rise in price, as well as bleaching-lime and all substances whose manufacture requires the use of this acid. If a commercial success, according to the authority indicated, chemical manufactures will undergo such a change as has rarely before been witnessed.—3 *A*, *October* 18, 1873, 485.

NEW METHOD OF MAKING PAPER PULP.

Mr. Keegan's new process for the manufacture of paper pulp from wood consists mainly in separating the ligneous fibres by means of an alkali. Soft wood, as, for instance, pine, is first cut into little tablets, from six to twelve inches long and half an inch thick. Uniformity of size is desirable, as insuring uniform rapidity of action upon the different pieces. These tablets are placed in a cylindrical vessel mounted on a horizontal axis, which revolves slowly during the operation. A solution of caustic soda of about 20° is next admitted to the wood, the vessel is hermetically sealed, and then, by means of a powerful pump, the liquid is completely injected into

every pore. A pressure of about fifty pounds to the square inch, for half an hour, is sufficient for this part of the process. After the wood has become completely saturated with the caustic, the excess of the latter is pumped away, to be used over again. The vessel in which this operation has been carried on is provided with a double envelope, so that between its walls steam can be introduced. The wood is thus heated up to nearly 300° Fahr. for two hours, at the end of which time its fibres can be easily separated by washing. This washing is continued until the escaping wash-water is perfectly limpid. A semi-pulp is the result of this process, which can be easily converted by ordinary means into a pulp suitable for the manufacture of paper. Bleaching may be performed either before or after this conversion, according to the color or quality of paper to be produced. In the entire process but little soda is really consumed, little time is wasted, and the woody fibres are completely freed from all resinous substances.—9 *B*, *February* 26, 1874, 97.

PURE COLLODION FROM CELLOIDINE.

A manufacturer in Berlin has succeeded in purifying gun-cotton in a cheap way, and in furnishing celloidine cotton or paper, as it is called, which affords a perfectly clear solution with ether and alcohol mixture. Furthermore, this does not cause separation of iodine from iodides not already decomposed by action of the air (as does iodide of ammonium), even after a long time; and the iodized collodion of this process which may be kept on hand is said to possess all other desirable properties.—13 *C*, *July* 1, 1873, 862.

PREPARATION OF RUSSIAN ISINGLASS.

The Russian isinglass, as it appears in commerce, is made from the swimming-bladder of the sturgeon, especially of the variety known as the Belouga (*Acipenser huso*). When of good quality, it should be pure white, brilliant, semi-transparent, dry, and horny in texture, and free from smell. It should dissolve in water heated to 90°–120° Fahr., without any residue, and in cooling should produce an almost colorless jelly. This isinglass is generally prepared by boys, under the supervision of older experts. The swimming-bladder is first placed in the water and left there for some days, with

frequent changes of the water and removal of all fatty and bloody particles. The warmer the water, the more rapidly the operation is completed. The bladders are finally removed, and cut longitudinally into sheets, which are exposed to the sun and air, being laid out to dry, with the outer face turned down, upon boards of linden or bass-wood.

The inner face is pure isinglass, which, when well dried, can with care be removed from the external lamellæ. The finer sheets thus obtained are to be placed between cloths to keep them from flies, and are then subjected to a heavy pressure, so as to flatten them out and render them uniform. After this they are assorted and tied up in packets. The packets composed of the isinglass of the large sturgeon usually contain from ten to fifteen sheets, and weigh a pound and a quarter; those of the others contain twenty-five sheets, weighing a pound. Eighty of these packages are usually sewed up in a cloth bag, or sometimes inclosed in sheet-lead.

The outer lamellæ of the air-bladder, after the isinglass proper has been removed, also contain a considerable quantity of glue, which, when softened in water, is scraped off with a knife and moulded into little tablets of about the size of a silver dollar, and then dried. This form of isinglass is packed in boxes, and is less expensive than the other.

It is said that an excellent isinglass has been made from the scales of shad and herring, which are first freed from their silvery coating. This may furnish a useful hint to persons who are near some of the great fishery establishments of the country; that at Alexandria, Virginia, for instance, where hundreds of thousands of shad are scaled and salted every year.—*Fisheries of the Arctic Seas*, *Schultz*, 1873, 67

DIFFUSION PROCESS IN MAKING SUGAR.

The diffusion process, which of late years has been extensively employed in Europe for the extraction of sugar from beet-root, has been subjected to very thorough tests in manufacturing sugar from the cane. The process has for some three years been in operation at the works of the Aska Company, Madras Presidency, East India, and has given admirable results. It yields, without much added difficulty, or much greater expense than the older processes, about 95.4 per cent. of the sugar present in the cane, thus increasing the

yield to an extent of over thirteen per cent., while the quality of the article produced is decidedly better.

M. Jules Robert, the inventor of the process, claims that it is now in use in over three hundred factories in Germany, Poland, Russia, and Holland. A complete apparatus for working up 100 tons of cane per day consists of one ten-horse-power engine and boiler, five cane-cutting machines of one horse-power each, 20 vessels, each of 170 cubic feet capacity, and one overhead reservoir holding 2000 gallons. About 7000 to 8000 gallons of water will be required (exclusive of that needed for the boilers) to form the diffusion juice, this being produced by the addition of one ton of water to the ton of cane slices.

PAPER INDUSTRY OF THE UNITED STATES.

From the *Paper Trade Journal* it appears that during 1872 there were in operation in the United States 812 paper-mills, owned by 705 firms, and representing a value of $35,000,000. In addition to this actual value of mill property, there is the usual working capital—22½ per cent. of the value of the mills—making the total capital invested in paper-making throughout the country about $43,500,000. The mills employ 13,420 male and 7700 female hands, besides 922 children—or a total of 22,042 laborers, whose wages amount to $10,000,000. The production of these mills during the year was 317,387 tons, valued at $66,475,825.

UTILIZATION OF CERTAIN OFFAL.

Professor A. H. Church, in a paper published in the "Transactions of the Highland Agricultural Society," refers to certain waste refuse matter, for the purpose of showing the economical products that may be obtained from them. According to this, fresh blood contains 3 per cent. of potential ammonia, 5 per cent. of potash, and 1 per cent. of phosphoric acid. Dry blood is five times as rich. Blood may be utilized as manure by mixing with dry peat, or by coagulation with 3 per cent. of quicklime, and then drying. Flesh, fish, hair, and wool are best prepared for manure by heating with steam under pressure. Horn, when gently roasted, may be powdered. Glue refuse is a slimy matter, containing in the fresh state 1.75 per cent. of nitrogen, and when dry 3.8 per cent. "Trot-

ter-scutch," a refuse of skin and hair from tanneries, is a cheap manure, containing in the fresh state 3.58 to 7.60 per cent. of potential ammonia.

Refuse hops from breweries contain, when fresh, 1.91, and when dry 4.20 per cent. of potential ammonia. They are best added to compost heaps. The deposits from fermenting liquors are always highly nitrogenous. Sugar-boilers' scum contains both nitrogen and phosphates; the scum from beet-root sirups appears the most nitrogenous, containing when dry 4.6 per cent. of potential ammonia. The liquors obtained by "retting" flax and hemp are nitrogenous, the solid contents yielding 2.7 to 4 per cent. of potential ammonia.—21 *A*, *December*, 1873, 1256.

PRODUCTION OF STARCH, PAPER, AND SOAP FROM CORN.

All the ingredients of corn, according to Leconte, may be utilized. The grain is, in the first place, to be saturated with a solution of caustic soda in large cisterns, and transferred to cylindrical sieves; then dipped in water, and ground in connection with a continuous stream of pure or somewhat caustic water. The quantity of soda, depending on its quality, the oily contents of the grain, and the temperature, should be such as to saponify the oil of the grain while allowing the starch to appear solid and firm. The liquid, as it leaves the mill, passes over sieves, on which the germs, hulls, etc., are retained, while the starch and soap pass through, and flow over large inclined surfaces, upon which the starch settles, and the dilute soap solution collects in cisterns. The starch is then washed with pure water in cisterns, again passed through sieves into cisterns, allowed to settle twenty-four hours, and, after drawing off the supernatant liquid, removed and dried. Excellent soap may be obtained from the dilute solution, and the germs, etc., can be utilized in paper manufacture.—8 *C*, *August* 28, 1873, 287.

SULPHATE OF AMMONIA FROM NITROGENOUS ORGANIC REFUSE.

All the nitrogen in the refuse of wool, hides, horn, leather, etc., according to L'Hote, is convertible into sulphate of ammonia by first treating it with a solution of commercial caustic soda in nine to ten parts, by weight, of water, in the cold, or at a gentle heat, thus partially dissolving, or at least com-

pletely disintegrating it. A doughy mass is then formed by stirring slaked lime into the gelatinous liquid, and distilling this, at as low a temperature as possible, in an iron retort, supplied with receivers containing oil of vitriol. When the evolution of gas has ceased, the retort is finally to be heated to redness. The white residual powder in the retort, consisting of carbonate of soda and caustic lime, on treatment with water, affords caustic soda, which may be used to renew the operation.—14 *C*, CCIX., 156.

EXTRACTION OF SILK FROM HALF-SILK RAGS, ETC.

Hitherto only all-silk material has been worked over, but Dr. Wagner claims to have discovered a process for obtaining silk from half-silk material which leaves nothing to be desired as to cheapness or rapidity. He also states that the silk extracted does not suffer in quality nor color, and can be rendered suitable for spinning either alone or mixed with new silk, according to the quality of the material from which it is separated.—13 *C*, *July* 1, 1873, 855.

AMMONIA CHLORIDE FROM BOILING ESTABLISHMENTS.

Terne, in Dingler's *Polytechnic Journal*, calls attention to a productive source of ammoniacal salts in the refuse from the slaughter-houses. He refers to the immense establishments near Chicago, where from 25,000 to 30,000 cattle are sometimes butchered in a single day. The refuse and the useless flesh are placed in a large iron boiler, and boiled under a pressure of three or four atmospheres. The fat rises to the top, and beneath is a liquid which might be considered a solution of glue had not the continued boiling under pressure completely destroyed its binding power. These tank waters, although useless for the manufacture of glues, are suggested by Terne as capable of being profitably utilized, since each quart can be made to furnish from seventy-five to one hundred grains of chloride of ammonia.—21 *A*, *November* 13, 1873, 1170.

UTILIZING WASTE ORGANIC MATERIAL.

Within the past few years there has grown up a new industry, based upon the saving of blood and other offal of the slaughter-houses, and the "tankings" (or bottoms of the

tanks) in which grease is rendered. All this material has heretofore been either wasted, or the attempts to utilize it have been so crude and ineffectual as to make the business not worth pursuing. At the present time, about New York, Chicago, Cincinnati, and Baltimore, a large amount of capital is employed, with machinery and skilled labor, by which many thousands of tons of dry, inodorous, nitrogenous matter is prepared and put in the market. It is sold readily at wholesale at about $3 75 for each unit of ammonia in a ton; *e. g.*, such as contains 10 per cent. sells at $37 50 per ton. It is bought by makers of fertilizers to furnish the proper proportion of ammonia in their compounds, and preference is said to be given to it over the Peruvian guano, which was formerly used for that purpose. In this case the buyer pays for only the actual ammonia contained in the dried meat, while the price for Peruvian guano is uniform, though the quality is variable.

UTILIZATION OF THE REFUSE FROM SCOURING WOOL.

For this purpose, according to Chaudet, sulphurous acid is introduced directly into the greasy water resulting from the operation until it is acidified; it is then allowed to stand for twenty-four hours, when an upper layer of impure fat, a middle one containing compounds of sulphurous acid with soda, potash, and ammonia, and a lower one of earthy sediment, will be found. The residue from the evaporation of the middle layer is to be ignited in a reverberatory furnace, to convert the sulphites into sulphates, which are dissolved out and crystallized. The upper layer is to be pressed through bags while hot, to obtain the fatty acids.—14 *C*, 1873, 465.

DETECTION OF FUCHSINE.

Fuchsine, one of the so-called coal-tar colors, is sometimes used in the adulteration of wine and liquors, and also for tinting bonbons. Being a deleterious substance, its detection is sometimes to be attempted, and the following method has been proposed by Doray. The suspected liquid is to be shaken violently in a flask with a mixture of two parts of benzine and three of carbolic acid. After standing quietly for a few moments, the two liquids of different density separate, the upper layer carrying with it the fuchsine in solu-

tion. This upper layer can easily be removed by means of a pipette, and the fuchsine verified by its decoloration with hydrochloric acid. By a process based upon this decoloration, using a standard solution of the acid, a quantitative determination of fuchsine may easily be made.—1 *B, February* 22, 1874, 356.

PREPARATION OF TRIPOLI FOR POLISHING VARNISHED ARTICLES.

Very finely pulverized tripoli is passed through a hair sieve, and stirred well in water with a wooden rod; the water with the fine tripoli in suspension is poured into another vessel, and allowed to stand for an hour or longer, until clear, and is then poured off. The powder obtained by drying the sediment on paper, in the sun or stove, is employed on felt or flannel for polishing varnished surfaces, with gentle friction, repeating the operation if necessary, and finally wiping with a fine cloth.—5 *C*, 1874, XIX., 151.

FRICTION WITHIN RIFLED GUNS.

Professor Reynolds, of Manchester, has presented an interesting memoir on the relative work spent, in friction, in giving rotation to shot from guns rifled with an increasing and also with a uniform twist. He shows that the friction between the studs and the grooves consumes more work with an increasing than with a uniform twist, and that in the case of grooves which develop into parabolas, such as those used in the Woolwich guns, the waste from this cause is double what it would be if the twist were uniform. Among his conclusions, Professor Reynolds states that when the pressure of the powder is constant, the work spent in friction in the case of parabolic grooves is 1½ times that spent in friction with plain grooves; and that this ratio becomes two when the pressure diminishes rapidly as the ball moves along; and, finally, that this ratio may have any value between 1½ and 2, but that it can not go beyond these limits.—*Jour. Soc. Tel. Engineers*, 1873, 56.

TREATMENT OF LUBRICATING OILS.

According to a patent of Baird, of Glasgow, the peculiar tendency of most oils and lubricants to oxidation is removed

by heating them in pans with two to ten per cent. of sulphur, according to the nature of the oil, until the sulphur is melted, and then allowing them to cool.—14 *C*, 1874, CCXL, 77.

FINE MACHINE OIL.

To prepare an excellent machine oil, mix 60 parts of oleine with 40 of olive-oil; or 50 of oleine, 40 of clear paraffine-oil, and 10 of olive-oil.—9 *C*, CCVIII., 109, 1873.

POLISHING POWDER FOR GOLD ARTICLES.

The following mixture, applied by means of a piece of leather, is highly recommended by Belgian goldsmiths for polishing true gold articles: ½ pound of chalk, 3¾ ounces of clay, 4 ounces of white lead, ¾ of an ounce of carbonate of magnesia, ¾ of an ounce of polishing rouge, all finely pulverized and intimately mixed.—14 *C*, 1874, 212, 80.

DEVELOPING THE CRYSTALLINE STRUCTURE OF TIN-FOIL.

The development of the crystalline structure of the tin of tinned iron, for purposes of ornamentation, has been known for a long time, this consisting essentially of the application of a slight acid to the exterior. Tin-foil can also be made to exhibit the same appearance, and in a still more characteristic manner; but the secret by which this was accomplished has until quite recently been well kept. The actual process, according to the *English Mechanic*, is as follows:

A perfectly plain and polished cast-iron plate is heated, by a number of small gas jets beneath, to a temperature of about 440°, or just short of the melting-point of tin, and the gas is so regulated as uniformly to maintain this temperature. A sheet of tin-foil is laid on this plate, and, to bring it in perfect contact therewith, a roller made of felt or soft cloth (similar to a printer's inking roller) is passed over the foil, which at this high heat loses elasticity and touches the plate all over. The next step is to fuse the tin-foil. To effect this, a row of little gas jets is carried over the upper surface of the foil with a small circling movement: this, in its passage, completely fuses the tin, which quickly congeals again, and may be at once raised, and the operation repeated on another sheet. The movable row of gas jets is simply a small tube perforated with a line of fine holes, and attached to a length

of flexible tube conveying the gas, thus allowing movement every way. It is scarcely necessary to state that, if the foil is not in close contact with the hot plate at any part, then a hole is sure to appear. This can not possibly occur where the foil is held together by every particle resting on the bed.

The foils now only require to have the crystalline pattern developed. This is done by immersing them for a few minutes in a mixture of equal parts of nitric and hydrochloric acids diluted with five parts of water. As soon as the crystals appear perfect, the foils are thoroughly washed, so as to remove all traces of acid, and then coated with hard, transparent varnish, which may be colored blue, red, yellow, etc., according to fancy. These colors must, of course, be transparent pigments, such as are well known to the varnish manufacturers.—18 *A*, *March* 13, 1873, 629.

EFFECT OF ALKALIES ON COTTON AND LINEN GOODS.

According to Jeanmaire, cotton or linen fabrics which have been impregnated with chromic acid, or a mixture of a chromate and an acid, or permanganate of potash, and which exhibit no perceptible change when washed, after the reduction of the chromic or permanganic acid has begun, are much impaired in strength by treatment with any alkaline liquid, even with soap; although the injurious change in the fibre will only be noticeable after some time, when the alkaline liquid is very dilute. Acidity of the oxidizing liquid is not a necessary condition, since the solution of permanganate of potash acts in the same way, even when slightly alkaline, and also a mixture of ferricyanide of potassium and alkali. Injurious changes of linen, frequently noticed when it is treated repeatedly with soap or lye, as well as unpleasant experiences in bleaching, may result from the same cause. Thus chromate of baryta or of lead, fixed on cloth, subsequently passed through an acid bath, may act in a similar manner. This reaction also serves to show whether a white or a yellow on indigo blue has been produced by means of a resist, or by printing an acid on the cloth impregnated with bichromate of potash; since, in the latter case, the white portion will become rotten when it is dipped in an alkaline solution.—6 *C*, *November* 5, 1873, 96.

SUBSTITUTION OF CHARCOAL FOR LIME IN REMOVING HAIR FROM HIDES.

The discovery of Anderson, of Scotland, that pulverized charcoal effects the removal of hair from hides, has been subjected to thorough trial by different manufacturers of leather, and with very favorable results, according to reports made through different journals. Since the charcoal, however, does not cause the hides to swell, a short previous liming, of two or three days, is still necessary; but this is not objectionable, as the charcoaling prevents any injurious result in addition to the action on the hair. The process can be carried on in the ordinary lime-pits at a temperature prevailing for the greater part of the year—namely, 50° to 70°; four to five days being sufficient at a temperature of 60° to 70°, while seven to eight days are necessary at 40° to 50°. The temperature is easily regulated by steam. Among the advantages, the following seem to be generally conceded: A decided economy of time, as well as of labor, since the subsequent operations are rendered easier and the tanning proper more rapid. The bran or dung bath may be entirely dispensed with. The liquids act uniformly without leaving specks. On account of the absence of disagreeable odors, the new process is more pleasant and less injurious to health. The leather is softer and better in quality, is easily worked, and does not tear out in sewing. There is a gain of one half to one pound in weight of leather per hide, while the charcoal, considering the amount required, etc., is found to be practically as cheap as lime.—14 *C*, 1873, CCX., 397.

NEW PROCESS OF ENGRAVING ON COPPER.

A new process of engraving on copper, with special reference to map-work, announced by Bougnet de Lagrye, commends itself on account of its simplicity and economy of cost. This consists essentially in first electro-plating, or otherwise coating, the object with a thin layer of silver, which is then evenly coated with a colored varnish. The outline topography and lettering are next to be marked in with a dry point, as is done with a diamond in engraving upon stone. These lines are then to be etched by means of the perchloride of iron. The labor of transferring the draw-

ing upon the plate may be greatly facilitated by the use of photography. It will be readily understood that the object of the silver coating is to secure a perfectly sharp and distinct outline after the etching has been accomplished.—6 *B*, *June* 1, 1874, 1536.

DIRECT PHOTOGRAPHY OF THE SOLAR PROTUBERANCES.

Professor Sellack, of Cordoba, who has the use of a 13-inch photographic objective, narrates his experience in attempting the photography of solar protuberances by means of the spectral line *H. Gamma.* According to him, a thin layer of iodide of silver upon a plate of glass absorbs all the violet light of the spectrum, and he therefore proposes to cover the surface of his lens with a thin layer of this substance. By means of the light that is then transmitted he would directly photograph the solar protuberances. His first attempts, for many reasons, have been quite unsatisfactory; but the suggestion seems worthy of further development by those spectroscopists who have greater conveniences at their command.—*Astron. Nachrichten*, LXXXIV., 90.

PREPARATION OF PHOTOGRAPHIC DRY PLATES BY DAYLIGHT.

The following process, suggested by Professor Himes, for the preparation of photographic dry plates, renders unnecessary the prolonged, unpleasant, and unhealthy confinement to the damp, dark room, and in a great measure lessens the liability to accidental stains on the plates. It rests upon the fact, ascertained by him, that at least any effect capable of development of light upon iodide or bromide of silver may be removed and further action of light prevented by the application of a solution of iodide of potassium, or of similar substances, or even by prolonged action of sunlight alone; but that these silver salts may again be rendered sensitive to light by treating them with a solution of tannin or of nitrate of silver, or by exposing them to fumes of ammonia. Glass plates, therefore, coated with the usual bromo-iodized collodion, are plunged in the nitrate-of-silver bath in an ordinary well-lighted room; the excess of nitrate of silver is rinsed off with water, and about a five-per-cent. solution of iodide of potassium is allowed to flow over them; they are again rinsed, and finally allowed to dry. Or the

flowing with iodide of potassium may be omitted, if the plates are exposed for several hours to the sunlight. In this condition they will keep indefinitely, and are rendered sensitive by simply moistening them in the dark with distilled water, allowing a solution of tannin, of fifteen grains to the ounce of water, to flow over them, and then drying them as usual in the dark. They will retain their sensitiveness for months. The exposure required in the camera is about the same as that for ordinary tannin plates, with the pyrogallic-acid developer, and the negatives are said to be cleaner. Instead of tannin, solution of nitrate of silver may be employed, or simple "fuming" with ammonia. Another process of similar character has recently been suggested by Krone, in which the action of light upon the sensitized plates is prevented by taking advantage of the fact that iodide of silver formed in the presence of excess of iodide of potash is not sensitive to light, but can be rendered sensitive by treating it with nitrate of silver, etc. A collodion is therefore employed, containing nitrate of silver instead of an iodide, and the plate coated with it is dipped in a bath of iodide of potassium. It is then washed and treated with nitrate of silver in the dark, to render it sensitive, and dried. The objection to this process is that it requires peculiar collodion and baths, while the other requires only the ordinary solutions.—4 *D*, *July*, 1874.

OBJECT-GLASSES FOR PHOTOGRAPHY.

In a paper on the transformation of the optical achromatism of an object-glass into chemical achromatism, Cornu finds that, given an achromatic telescope, the object-glass of which is formed of a convergent lens of crown-glass and a divergent lens of flint-glass, this object-glass may be formed into one capable of giving satisfactorily distinct photographic images by separating the two lenses to an extent dependent on the nature of the two glasses—a method which, by the by, was first introduced by Rutherford in 1850, but subsequently abandoned by him for a better. With the glasses used in optics a separation of 1½ per cent. of the focal distance of the object-glass is sufficient, and the chemical focus is then very near the optic focus. Using an excellent telescope of about four feet focal length, and separating the

object-glasses by 0.6 of an inch, he succeeded in photographing a divided scale placed at over one hundred feet distance; the lines were quite distinct.—12 *A*, X., 76.

SUBMARINE PHOTOGRAPHY.

Dr. Neumeyer's plan of a photographic apparatus, designed for the determination of the temperature and currents at the bottom of the sea, is described as follows: A copper box, hermetically sealed, is provided with an exterior appendix made like a rudder. A mercurial thermometer and a compass are in the interior, each in a glass receptacle, in which are admitted traces of nitrogen gas. A small electrical battery completes the apparatus. When the apparatus is lowered into the sea, attached to a sounding-line, the action of the current on the rudder indicates the set of the flow by the relative position of the compass-needle and rudder. The temperature is recorded by the thermometer. To fix these indications, a piece of photographic paper is suitably disposed near the glass case containing the instruments. At the proper moment a current of electricity is established through the gas in the receptacle, causing an intense violet light, capable of acting chemically upon the paper for a sufficient length of time to allow of impressing photographically thereon the images of the compass-needle and of the mercury column. The time required for this register is said to be three minutes, after which the instrument is hoisted, the paper removed, and replaced by another for a second observation.

CONVERSION OF LITHOGRAPHIC INTO LETTER-PRESS PLATES.

A perfectly smooth and polished zinc plate is first coated with weak phosphoric acid, then well wiped off, quickly placed over an alcohol flame, and rubbed dry with a woolen cloth. An impression on paper from the lithographic original in a moist condition is placed upon the zinc, and passed through the press several times. It is then treated as an ordinary lithographic stone, except that varnish is employed instead of oil of turpentine. The plate is next wiped off and dried, and the drawing dusted with finely powdered colophony, every particle of the latter being carefully removed from the free portions of the plate. It is then very

cautiously heated to the fusion of the colophony, and graphite dusted upon the plate and rubbed until the drawing acquires a decided lustre. The plate is then placed in a half-saturated solution of sulphate of copper until a black deposit forms upon it, after which it is removed, wiped off, and replaced in the copper solution, the operation being repeated two or three times, when the drawing appears in decided relief. The free portions of the plate are then coated with a mixture of gum arabic, ochre, white lead, etc., but not higher than the relief of the drawing, and when dry the whole is rolled with transfer ink. The drawing may be further strengthened by removing the layer of gum, immersing it in water, and treating it again with sulphate of copper, until the broad spaces are deep enough to allow it to be used in the letter-press.—14 *C*, CCXII., 1874, 258.

FIXING DESIGNS ON GLASS.

According to a process patented by E. Dodé, the surface of the glass is first finely ground, and any design then painted on it with a mixture of anhydrous boracic acid, gum, and water. When dry it is exposed to a temperature at which the boracic acid fuses, and imparts to those portions of the glass the usual lustre, and thus fixes the drawing. By mixing various metallic oxides with the boracic acid, designs in color may be produced.—15 *C*, 1873, xxiv., 384.

AUTOGRAPHIC REPRODUCTION OF DRAWINGS OF MACHINERY, ETC.

The process almost exclusively employed for the multiplication of manuscripts is suggested by Tailly for the reproduction of drawings of machinery, etc. A tracing of the drawing is first made in lithographic ink by placing it upon several thicknesses of heavy, very smooth paper on a drawing-board, and covering it with a piece of ordinary tracing-paper, previously coated with an emulsion of tapioca in pure water, and carefully dried, free from dust, and pasted by its projecting edges to the drawing-board, with the coated surface uppermost. When perfectly dry, the surface is rendered uniform by rubbing with erasing gum before the tracing is made. The lithographic ink, obtainable in solid form, is carefully dissolved by moistening it when pulverized with

a few drops of rain-water, rubbing it up with the finger, then bringing it to the consistency of ordinary drawing-ink with more water, and allowing it to stand for some time—best overnight. It will keep in this condition for several days, with the addition of water as may be necessary. Care must be taken not to touch the surface of the paper with the fingers. The tracing is transferred to stone by first placing it between folds of damp paper, to soften the tapioca coating, and then laying it face down upon a lithographic stone, and, with moist paper on top of it, subjecting it to pressure three times in succession; then passing a fine, moist sponge over it, and again pressing it as before. The paper thus loosened is finally entirely removed, leaving only the paste and tracing on the stone, which is next well washed with pure water, then coated with a solution of gum arabic, dried, washed with pure water, treated with acids, inked, and printed from in the usual way, affording, if proper care has been taken, 4000 to 5000 impressions.—6 *C*, *May* 14, 1874, 195

INDESTRUCTIBLE INK.

An ink closely resembling that forming the characters upon the Egyptian papyrus may be made, it is said, by dissolving gum lac in an aqueous solution of borax, and adding lamp-black in suitable quantity. This ink is claimed to be almost indestructible, resisting both time and chemical agents, and becoming a beautifully lustrous black.—4 *B*, *August*, 1874, 782.

NEW MANNER OF PRODUCING SHADED YARNS.

Instead of the usual method of letting down the yarn from time to time deeper into the dye-bath, by lowering the rods on which it is hung upon movable pins in holes in vertical supports, in order that successive portions may be more deeply shaded, it is much simpler, as well as much more economical, to dye first the whole skein in the bath, in the usual manner, to the lightest shade desired; allow it to hang, and draw off the bath by a stop-cock, or dip it out until its level is where the next deeper shade on the yarn is desired; then to lift the yarn, strengthen the bath, and hang it in again; and thus to continue as needed, to impart the different shades,

to draw off and strengthen the bath. As the deeper shades are successively imparted in diminished quantities of bath, which alone need be of the required strength, the economy of the process is apparent. It is said to be secretly employed in some establishments.—24 *C*, 1874, 137.

WEATHER-PROOF COATING FOR ZINC.

According to Puscher, the addition of sesquioxide of iron to a solution of basic acetate of lead affords a fine brownish-red permanent coating for zinc; and by the substitution of other pigments lighter or darker coatings, of any desired shade, may be imparted to architectural zinc castings. Deep black, permanent characters may be formed on clean sheet zinc by writing upon it, with a steel pen, with a solution of equal parts of chlorate of potash and sulphate of copper, in thirty-six times the quantity of hot water, and washing and drying the zinc after a few minutes. This fact may be especially useful to gardeners.—15 *C*, 1874, XI., 174.

WATER-PROOF COMPOSITION FOR COATING FABRICS.

Material coated, by means of a brush, with the following composition (patented in England), and then dried and exposed to the light, is said to become water-proof: Oil, varnish, and glycerine are added to a solution of caseine in ammoniacal water, and the mixture is boiled, and bichromate of potash added to it after cooling.—6 *C*, *May* 14, 1874, 198.

PREPARATION OF STARCH PASTE.

It is best to prepare paste by triturating the starch with cold water in a mortar until no lumps remain, and not too thick a mass is formed, and pouring into this boiling water, very slowly, with rapid stirring, until the paste begins to form, as indicated by the increase of transparency, and then rapidly adding the rest of the boiling water necessary for the paste. Boiling the paste is very injurious, rendering it less adhesive, and liable to peel off. Rye flour affords a more adhesive paste than starch, but of a gray color. The addition of a little alum to the water with which paste is prepared renders it more permanent, and the use of boiling lime-water instead of pure water adds to its adhesiveness. An aqueous extract of decomposed gluten, however, affords the

best paste with starch. By incorporating with the paste a quantity of turpentine, equal in weight to half of the starch employed, and stirring well while the paste is still hot, it will be rendered more impervious to moisture, and at the same time more adhesive.—25 *C*, XXII., 1874, 178.

MIXTURE OF PLASTER OF PARIS WITH MARSH-MALLOW ROOT.

An addition of two to four per cent. of powdered marsh-mallow root to plaster of Paris affords a mass that sets in about an hour, and becomes so hard, when dry, that it may be sawed and turned, and which is used for the manufacture of dominoes, dice, etc. With eight per cent. of the root a still harder mass is obtained. It may be rolled into thin leaves, and be painted, varnished, or polished.—13 *C*, *April* 1, 1874, 464.

ENGLISH ENAMEL FOR CAST IRON.

A brilliant, white, and very adhesive enamel is formed on cast-iron articles in the following way. After heating them to a red heat in sand, and keeping them at it for half an hour, they are allowed to cool slowly, and are then carefully cleaned with hot dilute sulphuric or hydrochloric acid, rinsed with water, and dried. A ground is next laid on by coating them with the following mixture, afterward drying them at a high temperature, and then heating them in separate muffles to vitrification of the coating: 6 parts of flint-glass, 3 of borax, 1 of minium, 1 of oxide of zinc, mixed and finely pulverized, and heated for four hours up to a red heat, and finally rendered semi-fluid by increase of temperature; after which the mass is quickly quenched in cold water, and one part of it is mixed with two parts of bone meal, and formed into a pap by triturating finely with sufficient water. Upon this ground the two following mixtures, prepared like the first, are then laid in succession, the first of 32 parts of calcined bones, 16 of kaoline, 14 of feldspar, 4 of potash, stirred up with water, dried, calcined, and suddenly cooled in water, and the powdered mass triturated with water to a fine paste with 16 parts of flint-glass, 5½ of calcined bones, and 3 of calcined quartz; after this has been put on and well dried, a second coating is applied of 4 parts of feldspar, 4 of pure sand, 4 of potash, 6 of borax, 1 of oxide of zinc, 1 of saltpetre, 1 of white arsenic, 1 of the best chalk; these ingredients are mixed, cal-

cined, suddenly cooled in water, and triturated with 5½ parts of calcined bones and 3 of quartz. The dried article is finally heated in a muffle, in a furnace similar to a porcelain furnace, when both coatings fuse and mix, thus forming the enamel. —5 *C*, 1874, XXI., 166.

SOLUBLE SESQUIOXIDE OF IRON IN DYEING SILK.

The injurious effect of the usually very acid mordants upon the durability of silk may be avoided by employing the aqueous solution of peroxide of iron, which remains in a dialyser, supplied with a bottom of animal membrane or parchment paper, and filled with a solution of chloride of iron, and floated for some time in a vessel of water, the larger part of the hydrochloric acid passing into the water. This solution is also much more effective than the usual iron mordant, since the affinity of the iron for the silk is not weakened by an acid. In fact, mordanting by iron salts seems itself to rest upon a dialytic process.—32 *C*, *May* 16, 1874, 240.

DYEING WITH ANILINE BLACK.

According to a process patented in France, the articles are first steeped for two hours in a solution of 6 pounds of iron in 20 pounds of hydrochloric acid and 2½ gallons of water, after addition of enough water to bring it to 12° Baumé. They are then exposed to the air for twelve hours, and are finally dyed by heating them in a water-bath, in a closed cylindrical vessel capable of turning on an axis, first to 86°, and then gradually up to 122° at the close of the operation, in an aniline-salt solution prepared, for 66 pounds of stuff, of 6.6 pounds of aniline and 11 pounds of hydrochloric acid, to which a solution of 4.6 pounds of chlorate of potash in 8 gallons of water has been added. The development of the color requires three to five hours, and it is fixed with bichromate of potash, and the goods are finally drawn through an oil-bath.—32 *C*, *May* 16, 1874, 238.

EGYPTIAN BLUE.

Specimens of the so-called Egyptian blue, taken from Roman ruins at Autun and a Gallic castle at Beuvray, were examined by Fontenay. They consisted of small round pieces about the size of a marble, and afforded a beautiful turquoise-

blue powder, which lost much in intensity of color by extreme pulverization. Uncombined grains of sand disseminated through it could be recognized with a lens, and before the blow-pipe it afforded a brownish frit. Even concentrated acids had very little or no effect upon it. Analysis showed it to consist of silicates of copper, lime, soda, iron, and alumina, without even a trace of cobalt. It was found possible to imitate it by heating, under certain precautions, an intimate mixture of white sand, black oxide of copper, chalk, and dry carbonate of soda.—5 *C*, xxv., *August* 27, 1874, 200.

WEIGHTING SILK WITH SULPHATE OF BARYTA.

Chevalier treats the raw silk ten minutes in a boiling solution of Glauber's salt, of 26° Baumé, then immerses ten minutes in a boiling solution of chloride of barium, of 34° Baumé, and finally washes. The operations are repeated several times, according to the strength of the charge desired. The baths should be alkaline, but their temperature and degree of concentration may be greatly varied, as the circumstances require; the former may even be as low as 50°. All the usual operations can be carried out afterward.—6 *C*, *April* 16, 1874, 159.

ARTIFICIAL COLORATION OF METALS.

A method for giving various tints to metals has lately been devised, and consists in coating their surfaces with a thin film of sulphide. It is said that in a few minutes articles of brass may be coated of any color varying from gold to copper-red, then to carmine, dark red, and through the several shades of blue, according to the thickness of the coating employed. The colors are said to possess good lustre, and, if the articles to be coated have previously been well cleaned, the coating will adhere with sufficient firmness to admit of polishing. The coloring solution is prepared as follows: Dissolve 1½ oz. of hyposulphite of soda in 1 pound of water, and add ½ oz. of acetate of lead dissolved in ½ pound of water. If this clear solution is heated to say 200° Fahr., it decomposes slowly and precipitates sulphide of lead. If a metallic surface is present, a portion of the sulphide is deposited thereon, and according to the thickness of this deposition will its color vary, as above described.

Treated in this way, iron takes a steel-blue color, and zinc a brown. Where sulphuric acid is substituted for the acetate of lead, brass will be coated with a beautiful red, which is followed by a green, and finally by a brown, with green and red iridescent glitter. A number of applications of this very useful discovery will doubtless suggest themselves.

NEW MATERIAL FOR DYE-STUFFS.

It is claimed that, according to a method patented by Croissant and Bretonnière, many kinds of refuse organic matter, as sawdust, decayed wood, horn, bran, starch, moss, etc., can be converted into valuable material for dyeing. The process rests upon the dehydrogenation of the substances by sulphur at high temperatures, and seems very simple in practice. Thus bran, for example, is simply mixed to a uniform paste, with the proper quantity of caustic soda and flour of sulphur, in an iron vessel, which is then covered, and heated in a furnace to 482°–570°. A portion of the sulphur is taken up by the organic matter, and much sulphureted hydrogen is given off; and at the close of the operation a friable, hygroscopic mass remains, which is completely soluble in water, of a sap-green color, and exhibiting an extraordinary affinity for organic fibres, so that they can be dyed with it without a mordant. The dyes formed, even from the same substance, may be varied in shade by altering the treatment; and some materials require a much higher temperature than others for their transformation.—14 *C*, CCXI., 404.

GOLD AND VIOLET BRONZE POWDER.

The process for preparing these so-called powders, by means of tin and fused acid tungstates, has been so improved by Dr. Schnitzler as to be adapted to the preparation of them, in suitable furnaces, by the hundred-weight, if the demand for them will justify it. He increased the amount of tungstic acid to such an extent that, by pulverizing the mass obtained by the fusion of the ingredients at a high temperature in a crucible, and heating it in a porcelain tube by a weak charcoal fire, it at most simply became adherent by fusion. The reduction was then accomplished in a few hours by common burning gas. By moderate tem-

perature the yield was considerable; and gold bronze, after repeated purification with hot nitric acid and with caustic soda, appears by sunlight as a beautiful gold-yellow uniform powder; by higher temperature it acquires a cast of red. The violet bronze (the potash compound) needs a higher temperature.—14 *C*, CCXI., 484.

NEW PROCESS FOR NICKEL PLATING.

Martin and Delamotte use organic acids with the salts of nickel instead of the mineral acids usually employed. The bath is prepared by dissolving 3858 grains of citric acid, 1543 grains of sal ammoniac or sulphate of ammonia, and 1543 grains of nitrate of ammonia in 6.3 pints of water, heating the solution to 176°, gradually saturating it with freshly precipitated hydrated oxide of nickel, and then allowing it to cool. One pint of ammonia is next added, and the whole diluted with water to 10.5 pints. Into this solution (which contains about 385 grains of nickel to the pint), when cold, 1543 grains of carbonate of ammonia are introduced, and the liquid filtered after settling. The liquid is deep blue, and of about 11° Baumé, and, under the influence of the current, readily affords a compact, brilliant, white deposit of nickel. The temperature of the bath during use must be retained at about 122°. Addition of caustic potash or soda renders heavier deposits possible.—15 *C*, 1873, XXIV., 384.

TINNING LINEN AND COTTON FABRICS.

Linen and cotton goods, according to Jacobson, may be tinned by first applying to their surfaces commercial zinc dust, rubbed to a thin mass with weak albumen, by means of a brush or roller. When dry, the albumen is coagulated by steam, and the goods are immersed in a solution of tin chloride. The tin is deposited in a finely divided state upon the zinc, and is then to be burnished. Linen prepared in this way is said to be a good water-proof substitute for tinfoil in many cases.—21 *A*, *July*, 1874.

BRONZING WOOD.

Saturate the article first with hot parchment glue, previously filtered and not too weak, and, when dry, coat while

slightly warm with red ochre mixed with a little yellow, and when perfectly dry coat a second time. Then rub the whole carefully with moistened shave-grass, and apply, with a bristle-brush, the bronze, of copper and brass or tin, mixed with alcohol. The article, as well as the bronze, must be kept warm during the operation, either in the sun or near a fire. Two or three coats are necessary to produce a perfect effect.—5 *C*, 20, 158.

CASTING CYLINDERS, CALENDERS, TUBES, PISTONS, ETC., OF GLASS.

According to a process patented by Chedgey, glazing-rollers, calenders, etc., may be cast of glass, in a cylindrical mould, provided with a movable bottom to which a rod is attached, which forms the core of the roller, by placing the movable bottom near the top of the mould at first, and gradually lowering it as the glass is poured in, thus preserving the casting free from air-bubbles. The casting is then annealed in the mould, and after the axis has been properly centred by wooden wedges, and fastened with cement, it is turned in a lathe with a diamond, the aid of emery, or sand and water, and polished as usual with rouge or putty. Pump pistons may be cast in the same way, and the rods fastened as usual by screw and nut. Cylinders to be turned and polished internally on the lathe are preserved from fracture by cementing them into a metallic cylinder, formed in segments, with plaster, and employing emery and water, and a polishing cylinder covered with felt. Straight and bent tubes can also be cast, with the advantage that they may be of any desired thickness.—14 *C*, CCXII., 254.

PREPARATION OF CORALLINE.

From a recent study of coralline, Commaille concludes: 1. That it is obtained at temperatures from 239° to 302°, the product being larger and the process more rapid at the lower temperature. 2. The quantity of oxalic acid required is not as large as generally stated. 3. Coralline forms no definite salts, but only lakes. 4. Yellow coralline is no acid, and rosolic acid is consequently a misnomer. 5. Red coralline is no amide of the yellow, since it contains no nitrogen. —32 *C*, *May* 16, 1874, 238.

A PASTE SUPERIOR TO GUM ARABIC.

A brilliant and adhesive paste, adapted to the uses of manufacturers of fancy articles, painters, etc., may be made by dissolving caseine precipitated from milk by acetic acid, and washed with pure water, in a saturated solution of borax.—5 *C*, xx., 160.

SEPARATION OF HONEY FROM THE COMB BY CENTRIFUGAL ACTION.

Superiority over all other machines of the kind is claimed for the centrifugal machine of Baron Rothschütz, for the separation of honey from the comb, in its applicability in all cases without reference to the size of the comb. It is also cheap, works easily and without noise, and can be readily taken apart and cleaned. The honey can be removed from the comb in from thirty to forty seconds, one man being able to work two hundred-weight in an hour.—13 *C*, *May* 1, 1874, 606.

REMOVAL OF BURS, ETC., FROM WOOL BY CHEMICAL AGENTS.

The so-called chemical method of cleansing wool, either raw or manufactured, from foreign vegetable matter, such as burs, straw, etc., is founded upon the well-known fact that strong acids, especially sulphuric, when diluted and aided by heat, destroy vegetable matter much more readily than they do wool. The importance of the process is indicated in a measure by the numerous patents which have followed its introduction. The wool is first placed in a bath of sulphuric acid of 3° to 4° Baumé, and the acid removed from it by a centrifugal apparatus, and finally placed for a suitable length of time in a chamber heated to 212°, where the vegetable matter is carbonized, while the wool remains uninjured. The adhering acid is removed by thorough washing. Careful investigations have been made by Duclaux, Lechartier, and Raulin, as to the conditions most favorable to the operation, and least liable to injure the wool. It was found that treatment of the wool with certain salts, as chlorides, sulphates, etc., before the operation, with a view to protect it from the action of the sulphuric acid, is not only worthless, but may even be injurious, in some cases, in the subsequent operations

of dyeing. Among the large number of chemical agents patented for the destruction of the vegetable matter, sulphuric acid alone was found to answer in practice. Experiments made by allowing certain portions of wool simply to drain after the steeping in the acid, wringing out other portions, and treating others in the centrifugal machine before placing them in the heated chamber for carbonizing the vegetable matter, showed that the employment of the centrifugal machine is necessary, not only for the most perfect preservation of the wool, but also for the best results in the subsequent operations of dyeing. A study of the relations existing between the degree of concentration of the acid, the temperature of the carbonizing chamber, and the time of exposure in the latter, with different kinds of wool, indicated that within proper limits no difference whatever in treatment is rendered necessary by differences in fineness or character of the wool. The particular degree of concentration of the acid in any case within the tolerably wide limits established, however, varies inversely as the temperature of the carbonizing chamber and the time of exposure in the latter. The color assumed in dyeing by wool thus treated was found, in general, to be nearer that of wool not thus treated the more dilute the acid employed, the lower the temperature, and the shorter the time required in the carbonizing chamber; but below certain limits it was normal and uniform, while above them it was pale, without brilliancy, and wanting in uniformity, though in different degrees with different colors; and it is a singular fact that thoroughness of washing after removal from the acid did not prevent the unfavorable effect of the use of too concentrated an acid upon the color. The results of these experiments were also confirmed by several other independent investigators.—13 *C, May* 1, 1874, 590.

CARBONIZATION OF HALF-WOOL STUFF.

Two processes, the so-called dry and wet, are employed for the removal of the cotton from half-wool material in the manufacture of shoddy. The first consists in bringing the material, in a suitably constructed iron carriage with a coarse sieve bottom, running on rails half-way up, into a closed furnace constructed of granite, the bottom of which is heated by

a fire beneath it to such a degree that the hydrochloric acid is vaporized rapidly, while the draft of the fire circulates around it so that it is warmed on all sides. After half an hour the carriage is run out, the rags are turned about, and it is run in again; the operation being repeated until, upon testing the rags with the fingers, it is evident that the cotton is entirely disintegrated. The rags are then neutralized in water containing whiting, and afterward dried. With woven material it is better to carbonize it by working it half an hour in sulphuric acid of 12° Baumé, containing two pounds of oxalic acid and two pounds of common salt, well stirred together and warmed, and then allowing it to remain in the bath without working for 1½ hours, and after letting it drain, on removal from this bath, drying it at 113° to 122°, and immersing it in a weak solution of soda to neutralize the acid, and finally washing it in pure water and drying.—24 *C*, 171.

PHOTOGRAPHIC IRRADIATION.

In order to prevent the irradiation attending the photographing of the sun, or other bright object, Mr. Stillman states that the most effectual means, where the dry process is available, is to allow the collodion to be acted upon by a large excess of nitrite of silver for a considerable time, and then to convert this into bromide of silver by the addition of ammonium bromide. The result is that the film has a dull, opaque character, like unglazed porcelain, and not only stops the light more completely than an ordinary collodion film, but reduces another cause of irradiation, namely, the molecular reflection of the film itself.—12 *A*, X., 1874, 63.

A SUBSTITUTE FOR IVORY.

A substance under the name of celluloid, the invention of Mr. Hyatt, of Albany, originally intended as a substitute for ivory in the manufacture of billiard-balls, possesses qualities which render it applicable to a great variety of manufactures. As originally prepared, it consisted of a combination of soluble cotton and ether or alcohol, but it was subsequently ascertained that a still more satisfactory result could be obtained by the addition of camphor to the alcohol; and, finally,

camphor alone was mixed with the ground cotton pulp, which hardens in drying and becomes celluloid. This substance—which is maintained by the inventor to be a truly chemical compound, and not a mechanical mixture—can be colored in any way desired. The varying degrees of solidity and flexibility required are obtained by the different proportions of the camphor. The substance is naturally of a pale amber color, but may be made of any tint by the application of mineral pigments or dyes soluble in alcohol, or any of the aniline colors may be employed.

Celluloid is hard and elastic, ranging in hardness from that of iron to ivory. It is as tough as whalebone, elasticity being one of its most prominent characteristics. In this respect it greatly exceeds ivory. It makes good insulators for knobs of telegraphic instruments, for insulating posts for electrical machines, and for telegraphic wires; as, although a good non-conductor, it is not perceptibly electric. It is well adapted to the manufacture of combs, and is largely used in the preparation of dental plates, as it can be made of precisely the color of the palate and gums. At a temperature of 250° to 300° it can be moulded into any desired form. Several companies have been started for the manufacture of different objects from celluloid; among them the Celluloid Novelty Company of Newark, and the Celluloid Harness-trimming Company of the same city, and several others in Philadelphia, New York, and elsewhere.—17 *A*, *September* 1, 1874, 139.

VERY SIMPLE AND CHEAP FOUNTAIN-PEN.

In spite of the recognized desirability of a pen that will retain a supply of ink for some time, no one of the various and more or less complicated forms of so-called fountain-pens has proved entirely satisfactory, although generally comparatively expensive. According to the following plan, suggested by Engineer Klette, any one can in a few minutes construct a pen of the kind that will be perfectly satisfactory. Two ordinary steel pens are fixed in the same holder in such a way that they may be separated by a space of about one twenty-fifth of an inch, and that the point of the upper one may be a little above that of the other. By selecting for the upper pen one with a bend in the middle, this will be most

readily accomplished. In dipping into the ink, it rises and fills the space between the pens, and flows down gradually as wanted in writing.—15 *C*, XII., 1874, 190.

GREEN BRONZE FOR IRON.

A most beautiful and permanent green-bronze coating may be imparted to cast and wrought iron, sheet iron, wire, etc., according to Paul Weiskopf, by a solution of one part of sylinate of silver in twenty parts of oil of lavender. The surface to be bronzed must be well cleaned (not necessarily polished) and dried, and then lightly coated with the liquid by means of a hair pencil, and warmed rapidly up to 302°, the proper temperature being readily recognized by the uniform, brilliant, intense green color of all portions. Designs in bronze may be produced by substituting Venetian turpentine, or a solution of colophony in oil of lavender, for a portion of the oil of lavender, by rubbing the dry sylinate of silver with the resin, and adding oil of lavender to the consistency of ordinary paint. Iron articles thus bronzed may subsequently be electrically coated with copper, and the latter will not be deposited on the bronzed places. Articles of copper, brass, etc., coated with the above solution and heated to about 482°, become covered with a gray, dull film of silver, of a reddish cast, which is not permanent, but after being varnished presents an appearance similar to the so-called oxidized metals.—14 *C*, CCXIII., 1874, 358.

PAPER IMITATION OF LEATHER.

A most deceptive imitation of leather is manufactured, according to a process discovered by Dawidowski, from parchment paper. It is as soft and pliable as leather, and resembles it perfectly in color and finish, and, like it, can be glued, pressed, stamped, gilded, etc. It therefore forms a perfect substitute for fancy leather for very many purposes. As binding of books it resists abrasion extremely well, and is not affected by dirt or even water. It is also free from the objections to leather as a lining for hats, since it is unaffected by perspiration.—5 *C*, xxx., 1874, 239.

VALUE OF JUTE FOR FABRICS.

The place which jute now occupies among raw materials wrought into useful articles, in Great Britain, may be inferred from the fact that the quantity annually imported nearly equals that of flax. It is used not only for the production of various kinds of coarse textile fabrics, but also for hats, paper, carpets, and to a very great extent for women's chignons. According to Dr. Hodges, the difficulties hitherto experienced in bleaching jute may be removed by passing the raw material successively through baths of alkaline solutions and of hypochlorite of magnesia and soda. In practice, jute may be distinguished from hemp by its striking a deep golden yellow with aniline sulphate.—15 *A*, *August* 29, 1874, 278.

N. MATERIA MEDICA, THERAPEUTICS, AND HYGIENE.

ANTAGONISM BETWEEN BELLADONNA AND THE CALABAR BEAN.

According to numerous experiments by Professor Fraser, 22½ grains of atropine and 1½ grains of the extract of Calabar bean are the smallest amounts of these substances respectively necessary to kill a rabbit weighing 3½ pounds; and the sulphate of eserine has tenfold the effect of the extract. Dogs are more easily affected than rabbits by atropine, 15 grains being sufficient to kill a dog weighing 16 pounds. The minimum of eserine necessary to produce death may, however, be greatly exceeded, doubled, or even trebled, without poisonous effect, if a certain amount of sulphate of atropine is administered with it; and the question naturally arises whether eserine and atropine neutralize each other in cases of other animals, especially since dogs and rabbits are not very sensitive to atropine.—18 *C*, *October* 29, 1873, 695.

AUSTRALIAN CURE FOR DIPHTHERIA.

The Australian newspapers have had much to say about a cure for diphtheria, as discovered by Mr. Greathead, the secret of which was offered to the government at a large price, and which was subsequently found to consist in the administration of four drops of sulphuric acid in half a glass of water. This causes vomiting, accompanied by the breaking away of the diphtheric matter which produces the suffocation. As the disease is very prevalent in Australia, the government has offered a reward of £5000 for an absolute cure, and Mr. Greathead is quite confident in securing this, since he claims that in nearly every instance he has been successful in the application of his remedy.—2 *A*, *December* 27, 1873, 528.

EFFECT OF SENNA ON THE URINE.

Professor Gubler has lately observed that the urine of persons who have taken senna becomes of an intense yellow color, with a green reflection, just as in jaundice; and the

application of nitric acid shows that bile has nothing to do with this coloring. If a fragment of caustic potash be let fall to the bottom of a tube containing urine charged with senna, a magnificent purple color is produced; but nothing of the sort takes place under the influence of potash in icteric urine. This coloring has been observed in all the patients who have taken senna whose urine has been examined—even where only half an ounce of the infusion, or a black draught of the codex, has been administered.—20 *A*, *August* 30, 1874, 237.

MAGNESITE FOR SURGICAL BANDAGES.

Magnesite, a natural carbonate of magnesia, is suggested by Küster for use with surgical bandages, as being superior to gypsum in lightness, firmness, cleanliness, simplicity, and rapidity of application, and in resistance to moisture, cheapness, and permanence. For use, one part of finely pulverized magnesite (according to Böttger, dolomite also answers exceedingly well) is stirred gradually into three parts of water-glass solution, thus forming a thin paste, through which one or more linen bands are drawn, so as to become completely saturated. They are then wrapped in two, or at most three, layers around the limb, previously enveloped in flannel bands. In twenty-four to thirty-six hours, during which the limb must be kept still, it will acquire a stony hardness, will endure any weight, and last without apparent change for months.—14 *C*, CCIX., 1873, 153.

CURE FOR A COLD.

The general superintendent of the royal theatres in Berlin recommended the following recipe, by Dr. Hagar, to the actors under his charge as a certain remedy for incipient catarrh, and as without any injurious effects. Mix five parts of pure carbolic acid with fifteen of alcohol, and five parts of aqua ammonia (sp. gr. 960) with ten of distilled water, and preserve the two mixtures in separate glass-stoppered bottles. For use, pour a few drops from each bottle into an empty tumbler, and with the eyes tightly closed, and the mouth and nose immediately above the tumbler, inhale the vapor from the mixture. The momentary pungent sensation in the nose may not be pleasant at first, or may even be painful in acute ca-

tarrh, but all, even small children, soon become accustomed to it. All the ingredients may be combined at once instead of in separate portions (as given), but the mixture may then acquire, with an aniline tint, a penetrating, disagreeable odor. —15 *C*, 1874, XIV., 233.

PATHOLOGY OF MUMPS.

According to Bouchut, mumps, which have been considered as an inflammation of the parotid gland in adults, or a somewhat similar affection in children, really arise from a retention of saliva, caused by a catarrhal inflammation of the parotid duct. Under the influence of this catarrh of the excretory canal a temporary obstruction is caused, which retains the saliva. In healthy children this disease is not a serious one, as suppuration does not take place. On the other hand, however, where suppuration does occur, death often results. The only way of averting this, according to the author, consists in making numerous small incisions in the substance of the parotid, before the pus, which is infiltrated into its substance, has time to collect.

HAY FEVER.

Decaisne has lately been prosecuting some inquiries in reference to the disease so well known in this country under the name of hay fever, or rose cold, and he remarks that the affection appears to attack agriculturists and persons of other occupations indifferently, and that there is no greater tendency to it among hay-makers and farmers than any other class of the community. He therefore maintains that the emanations from forage plants have, at most, a very secondary influence in the case. All the symptoms of the disease are exhibited, at any season, as the result of sudden exposure to cold when the body is in a condition of perspiration, whether subjected or not to dust or other irritating emanations.

The author does not think the annual periodicity, which is usually given as one of the characteristics of the disease, to be well established; many persons, according to his observation, being sometimes free for years in succession, and others experiencing several attacks at irregular intervals. The difficulty of breathing, which is sometimes considered an inseparable condition of hay fever, the author maintains to be sim-

ply the result of the more decided extension of the irritation which attacks the conjunctiva and the nasal and pharyngeal mucal surface. He concludes, in fine, that hay fever must be stricken from the list of diseases as a distinct condition, and that it is to be regarded simply as a catarrhal fever, influenced and modified in its origin and progress according to individual peculiarities, and by atmospheric conditions which produce acute affections of the bronchia.—1 *B*, *October* 19, 1873, 46.

CAUSE OF PUTREFACTION IN EGGS.

According to Gayon, the putrefaction of eggs corresponds with the development in them of vibriones, and these he thinks are introduced in the egg while in the process of formation in the ovary, but do not penetrate as high as has sometimes been supposed. In proof of this fact, the author in examining the oviduct of a recently killed fowl has found both bacteria and spores of fungi. Their number diminishes in passing up the oviduct, but they have been seen as high as four or five inches from its aperture, and there is no reason why they may not pass up still higher.—21 *A*, *November*, 1873, 1150.

RESEARCHES ON DIABETES.

Among the more important of the conclusions announced by Professor Claude Bernard, of the College of France, as the result of his investigations upon diabetes, is—1st, that sugar exists in a normal condition in the blood and liver; but for the demonstration of this fact recourse must be had to fresh blood from a vein or artery, as it decomposes very rapidly after death. Diabetes is simply an exaggeration of the conditions under which sugar is normally formed. 2d, any surplus of sugar in the blood is always eliminated by the kidneys; and, as a general rule, while there may be 70 parts of sugar in a thousand of the urine, we can not have more than 2 or 3 parts in the blood. 3d, the sugar in the blood is derived from the liver, and the action of the nervous system is exercised upon it through the circulation. 4th, the opinion of those who consider the presence of sugar in the liver and in the blood as a cadaveric phenomenon is entirely erroneous; on the contrary, the presence of sugar in the blood is a

normal condition of all animals in a state of perfect health, and is wanting in those only that spend part of their lives in a condition of suspended animation, and during that period, as, for example, the hybernating animals. Indeed, the sugar in the blood is in direct ratio to the phenomenon of nutrition, and of development and organic renovation. It is considerable in the fœtus; it reappears as soon as the hybernating animals return to active life. Sugar appears in greatest quantity after losses in the system, and in proportion to the deficiency to be supplied.

A normal condition of sugar in the blood corresponds to a perfect equilibrium between the nutritive phenomena of assimilation or of disassimilation. The moment this equilibrium is disturbed its restoration is aimed at, and the liver acts more decidedly and furnishes more sugar to the blood. This condition in the system is a salutary tendency to repair the injuries to nutrition, and it is exaggerated in proportion to the perturbing action, and may vary considerably from time to time.

In diabetes the sugar in the blood (which involves sugar in the urine) is not in reality the disease; on the contrary, it is only an effort of the system to repair damages, a physiological phenomenon analogous to those of organic development, whether vegetable or animal. The true etiological element of diabetes, as a disease, is that condition, unexplained at the moment, which brings about the primitive organic exhaustion; and it is to this cause that attention should be directed, rather than to the mere fact of the existence of sugar in the blood or the urine.—1 *B*, *September* 14, 1873, 463.

RAPID CURE FOR CATARRH.

According to Hamilton, the severest catarrhal cold can be removed in about ten hours by a mixture of carbolic acid, 10 drops; tincture of iodine and chloroform, each 7.5 drops. A few drops should be heated over a spirit-lamp, in a test-tube, the mouth of which should be applied to the nostrils as soon as volatilization is effected. The operation should be repeated in about two minutes, when, after sneezing a number of times, the troublesome symptoms rapidly disappear.—18 *C*, *October* 29, 1873, 695.

POISONOUS NATURE OF COBALT COMPOUNDS.

M. Siegen has found that the compounds of cobalt must be classed among the poisons. His experiments were made with the nitrate and the chloride of the metal. One centigramme of either salt (about 0.15 grain) killed a frog in half an hour; three centigrammes killed a rabbit in three hours. The poison seems to retard the action of the heart.—3 *B*, *October* 2, 1873, 155.

ACTION OF DIFFERENT WIRES OF INDUCTION COIL ON THE SYSTEM.

According to Mr. Onimus, the physiological effects of the induction current in stimulating the nerves and muscles differ, according to the material of which the wire is formed; this being shown in the fact that when the wire is constructed of a metal that conducts electricity badly, the contractions are much stronger, and the impressions on the cutaneous nerves less vivid, than with good conducting wires, such as copper, the current induced in the badly conducting wires having much greater tension than that in good conductors. According to Mr. Onimus, German-silver wire may be substituted for copper to advantage in many cases. We presume our medical electricians will take due note of these considerations.—18 *A*, *January* 2, 1874, 380.

ALCOHOL AS A REMEDY FOR BURNS.

Alcohol, recommended by Sydenham, has lately been employed by Leviseur, particularly with children, as the most rapid and effective means of alleviating the pain of burns. The affected part is either simply covered loosely with an alcoholic compress, or is bathed with alcohol, when the pain instantly disappears, but returns again when the application ceases. It must, therefore, be continued for one to two hours, and then be repeated at longer intervals, until the reddened epidermis is bleached and shriveled, or until any blisters that may have formed have opened and discharged, which will take place in from six to twelve hours. Care must be taken, especially where the surface to be treated is large, that the vapor of the alcohol does not affect the patient.—18 *C*, *October* 29, 1873, 695.

RELATION OF EARTH STRATA TO THE COMPOSITION OF WATERS.

Dr. List has been prosecuting some inquiries in reference to the variations in composition of spring and river water, in the course of which he comes to the following conclusions: First, the qualitative and quantitative composition of the water and its physical peculiarities are dependent upon the characteristics of the strata in which the water originates. Second, that the amount of carbonic acid is greater in springs rising in limestone districts, or which pass through limestone strata, than in those from sandstone formations. Third, that the amount of carbonic acid is, in some degree, dependent upon the temperature of the water. Fourth, that the amount of inorganic residuum varies in very narrow limits, and is greater in autumn than in spring. Fifth, that the amount of this residuum, and that of carbonic acid, have no direct relation to each other. Sixth, that the total degree of hardness is in proportion to the amount of ash; the temporary hardness to the amount of carbonic acid, this being greater in autumn than in spring. Seventh, that the rain-fall increases the amount of ash in spring water, wherever there is soluble material in the soil to be washed out, and this in direct ratio to the amount of rain-fall. Eighth, that nitric acid is specially discernible in water after a heavy rain, and after great cloudiness and thundery weather. Ninth, that ammonia and nitric acid occur when the falling rain filters through into water in elevated ground. Tenth, that the occurrence of organic material is independent of the occurrence of the fixed constituents. Eleventh, wood and other similar bodies furnish to running water no increase of nitric acid; on the other hand, they supply rich quantities of oxidizable combinations and greater quantities of ammonia.—*Studien zur Statistik der Wasser*, *E. List*, 1872, 50.

ACTION OF SALT AND POTASH SALTS ON THE SYSTEM.

Careful study was made by Bunge of the remarkable fact that herbivorous animals, domestic as well as wild, exhibit a necessity for salt beyond the amount in their natural food, while the carnivorous do not, although the latter do not obtain any more in their ordinary nutriment. Also that, while

the amount of soda is equivalent to that of the potash in the food of carnivora, in that of the herbivora the potash salts are double in quantity those of soda. Comparison of results of experiments showed that, while herbivora obtain no less sodium and chlorine in their food than the carnivora, they secure two to four times as much potash. By giving doses of different potash salts, and determining the amounts of different salts excreted, he found, as the most evident effect, a decided increase of sodium and chlorine on the day of administration, and diminution below the normal amount on the subsequent day; and also that, besides chloride of sodium, additional soda must have been excreted, since the sodium, usually present in amounts chemically equivalent to the chlorine, was in excess. Any explanation based on mechanical displacement, increased diffusion and filtration of the salt by the salts entering the blood, is not sustained by the experiments; but it is more plausible to suppose that mutual decomposition and recomposition of the potash salts introduced, and of the soda salts in the blood, take place, and the potash and soda salts thus formed, not being normal constituents of the blood, are excreted. There are indications that this change probably begins, and is carried on in part, in the stomach and intestines. It also appeared that the phosphate, after resorption, was partially combined with the blood corpuscles, and gradually given up by them, and that the blood corpuscles, therefore, with their other functions, tend to render the harmful matter present in all nutriment harmless. In support of this view, there is the fact that, in normal blood, potash salts are found almost exclusively in the corpuscles, and principally in combination with phosphoric acid, while these salts are intensely poisonous in the plasma of the blood. Although potash may, within limits, exceed soda in certain food, without removing soda from the system (as in milk, the food of young mammals), it must be remembered that the greater part of the potassium in these cases is in the form of chloride of potassium, which, according to incomplete experiments, is less effective than other potassium compounds. Since rye, potatoes, etc., the food of the laboring classes, contain potash salts largely in excess of the soda salts, the author is inclined to regard common salt as a necessary nutriment as well as a condiment.—28 *C*, *July*, 1873, 27.

ANÆSTHESIA IN OPERATIONS ON THE EYE.

In referring to the great importance of anæsthetics in direct operations upon the eye, Dr. Schweigger, of Berlin, insists upon the necessity of selecting one that will permit the patient to be kept sometimes for at least an hour under its influence, without involving any danger to life or health; since it is not merely sufficient to render the patient unconscious, but the cornea must be so insensible as to allow the contact of the finger, or the introduction of the instrument, without the excitement of reflex action in the eyelids and muscles. The use of chloroform in such cases he considers very undesirable, ether being much superior in safety. He states, however, that whatever be the anæsthetic employed, a strict watch should be kept over the patient, and especially upon the state of the pupil. A moderate dilatation of this should warn the operator to be very careful, while a suddenly occurring and wide dilatation is always a sign of impending asphyxia. The moment this is observed, or when the respiratory movements are insufficient or arrested, the tongue should be drawn out of the mouth by means of a hooked forceps. The respiratory movements, which had been arrested by the falling back of the root of the tongue on the epiglottis, are then resumed. To this, the most simple and longest-known procedure, Dr. Schweigger attributes his having been able to restore several patients who were in a most dangerous condition.—20 *A*, *November* 15, 1873, 556.

POLLUTION OF RIVERS BY MANUFACTORIES AND CITY SEWAGE.

The great attention recently given to these sources of disease and discomfort, by various European governments, seems more than justified, according to an exhaustive summary, by Fischer, of the results of these investigations. Thus, the refuse water of almost all industrial establishments contains more or less matter in solution, or suspension, calculated to render it unwholesome and unfit for many purposes. The nitrogenous organic material, however, seems specially objectionable. Tanneries contribute so much of this that their interdiction near large cities is suggested. Paper mills, in the washings of the rags and of the esparto grass, also furnish a liquid prone to putrefaction. The refuse water of sugar

manufactories, besides being very rich in nitrogen, readily passes into putrefaction by reason of its comparatively high temperature, so that streams are covered with scum from it for miles, and the fish are exterminated. The waters from manufactories of starch and spirituous liquors have similar properties. Washing, bleaching, dyeing, and printing processes generally, add to water a refuse rich in organic matter; that from woolen and carpet manufactories being much more impure, and that from silk much less impure than that from cotton factories. To the preceding may be added manufactories of chemical products and dye-stuffs generally, and fat-extracting establishments; while soap-boiling seems to be but slightly objectionable in this respect. Numerous plans for utilizing refuse of this character from different sources, and thus preventing pollution of the rivers by it, have been suggested. But, besides organic matter, arsenic is frequently met with, and sometimes not in trifling quantities, especially in the water from soda manufactories, on account of its frequent presence as an impurity in the sulphuric acid employed; and for the same reason, in part, it is also found in that from dyeing establishments, as well as in part also on account of arseniate of soda employed with madder colors. In woolen factories the soda and soap employed add arsenic to the other contaminating matter; and, generally, whenever large quantities of sulphuric acid are employed, perceptible traces of arsenic may be found; it also occurs in the refuse of aniline manufactories. Free hydrochloric acid is added in large quantities by soda-works, and chlorides from bleaching establishments; while sulphureted hydrogen and, ultimately, free sulphur are frequently liberated from soda residues by the action of the acid waters.

The sewage of cities, however, with its accumulations of domestic refuse, of rain-water washings from the streets, and excrementitious matter, contributes the largest share to the sum total of putrescible nitrogenous refuse, although its filthiness may at times be masked by the refuse products from manufactories; while the organic contents are not rapidly destroyed, as is supposed, by mixing it with twenty times its quantity of river water. The remedies suggested, in connection with the various species of impurities, are almost without number; prevention, principally by the separate removal

and utilization of the solid portion, being the first to suggest itself. But this does not seem to meet the case; and, consequently, purification of the polluted water must be resorted to, either by means of chemical reagents or of filtration, or of some method of irrigation with the water. To effect this, many chemical reagents have been experimented with, and numerous combinations have been patented: lime, salts of alumina and iron, carbon, and clay entering most frequently into the processes. Filtration, downward and upward, through sand, etc., has also been extensively tried; but none of these afford satisfactory results, as far, at least, as dissolved organic matter is concerned—not even half of it being eliminated by any of the chemical methods. The purified water has frequently been found to develop animal life copiously.

By intermittent downward filtration, through sand, however, the filters being allowed to remain idle from six to twelve hours, and this being resaturated with absorbed oxygen, the organic matter seems to be completely removed, and the purification is altogether satisfactory. But the cheapest and most convenient method for the removal of all sorts of putrescent city refuse is through sewage, and its subsequent purification by some one of the methods of irrigation with it; and it is, at the same time, the means decidedly best adapted to the agricultural utilization of the ingredients. Objections to this plan, based upon the possibility of the production of miasmatic or other unhealthful influences by it, do not seem to be warranted by experience, even during the prevalence of cholera.—14 *C*, 1874, CCXI., 200.

THERAPEUTIC VIRTUES OF PHENATE OF AMMONIA.

Dr. Déclat urges the value of ammonia, and of the phenate of that alkali, in treating cholera and ferment diseases, including those resulting from the bites of certain serpents. These remedies tend to prevent the solidification of the blood in fermentative diseases, especially the phenate; they can also be used with good results in cases of confirmed cholera, either administered by the month in the proportion of one half of one per cent., or as a hypodermic injection of 100 drops of 2 to 2½ per cent., or by injection in the veins. In this latter case, however, the phenate must not be stronger than one half of one per cent.

THE VAPOR-BATH IN HYDROPHOBIA.

According to Dr. Buisson, of Lyons, an almost certain cure for the bite of a mad dog consists in subjecting the patient daily to the influence of a vapor-bath, heated to 134° to 144° Fahr., for seven successive days, for the purpose of throwing him into a profuse perspiration, and thus eliminating the poison through the skin. When the disease has actually declared itself, it will be sufficient to take one vapor-bath, in which the temperature is made to rise rapidly to 98° Fahr., and then slowly to 127°, the patient keeping his room until the case is complete. A few hot bricks placed in a pail of water over which the patient sits on a cane-bottomed chair, a large blanket covering him in, from his shoulders down to the floor, can be easily improvised, and is said to answer the purpose of a vapor-bath admirably. This remedy is the result of the personal experience of Dr. Buisson, he having been subjected to the attack of a rabid dog, and affected with all the symptoms of hydrophobia. Having a theory in regard to the efficiency of vapor-baths in such cases, he tried the experiment, and found that when the temperature reached 125° Fahr. the symptoms disappeared as if by magic. Since then he *has* treated more than eighty persons bitten by mad animals, and, according to his account, has not lost a single case.—18 *A*, *May* 1, 1874, 165.

REMOVAL OF CARBONIC ACID FROM WELLS AND CELLARS.

Recently ignited charcoal absorbs about thirty-five times its volume of carbonic acid in twenty-four hours. A pan of glowing charcoal, therefore, lowered into a well or cellar containing carbonic acid, soon ceases to glow, and begins immediately to absorb the gas. By testing the air, from time to time, by lowering a lighted taper into it, and renewing the coal from hour to hour as long as necessary, all the carbonic acid may be rapidly removed.—34 *C*, 1874, XII., 53.

CARBOLATE OF AMMONIA FOR MALIGNANT PUSTULES.

Dr. Déclat, who attaches great importance to carbolic acid in one combination or another as a remedy, has lately urged with much earnestness the virtues of carbolate of ammonia in treatment of malignant pustule or charbon. This substance

is applied first as a caustic, and then administered internally in a dose of fifteen to thirty grains in twenty-four hours. In one instance four butchers were attacked with malignant pustule, derived from infected cattle, and two were attended at home, while the other two were carried to the hospital, and placed under Dr. Déclat's care, and treated with the carbolate of ammonia as above described. These were entirely cured in a reasonably short space of time; while the others, who were treated at home by the ordinary methods, succumbed to the malady.—13 *B*, *October* 18, 1873, 319.

PROPER APPLICATION OF THE CAUTERY.

Dr. Camden, in a communication to the *Medical Times and Gazette*, in reference to the cautery for snake-bite, etc., calls attention to the fact that when this remedy is applied the iron should be of an intense white heat, as in this case it produces in many instances absolutely no pain whatever, while if the iron be simply red-hot the effect is almost agonizing. He has noticed the difference in numerous instances in man; and in one case when the application was made by a white-heated iron to the shoulder of a horse, the animal scarcely seemed conscious of what was done to him. In cases where it is difficult to obtain the aid of a furnace to secure the white heat necessary, Dr. Camden suggests the employment of a large spirit blow-pipe, the iron being held on a piece of pumice-stone.—5 *A*, *July*, 1873, 320.

BROMIDE OF POTASSIUM AS A REMEDY.

Dr. Binz, of Bonn, has lately endeavored to show that the value of bromide of potassium as a drug, in diseases of the nervous system, such as epilepsy and its allies, has been overestimated, and that the action is probably due to the potassium rather than to the bromine; also, that the therapeutic influence of the bromide of potassium is owing to a general improvement of nutrition, caused by the addition to the blood of potash salts in excess, and that other preparations with potassium would answer the same purpose.

To this Dr. Anstie responds by pointing to the uniformly favorable experience of English physicians of the controlling action of the bromide over epilepsy and some other diseases, while it is scarcely less marked in cases of insomnia and rest-

lessness. Dr. Anstie, however, admits that, in aged persons, the bromide sometimes aggravates the symptoms it was intended to relieve. He states that he has experimentally proved the uselessness of bicarbonate of potassium and nitrate of potassium, in cases of epilepsy, given sometimes in full doses, and maintains that it is the combination of bromine with potassium that is necessary to produce the desired effects.—20 *A*, *February* 14, 1874, 185.

AGENCY OF MILK IN SPREADING TYPHOID FEVER.

Considerable interest has been excited in medical and sanitary circles by the occurrence of an epidemic typhoid fever in London, which, after careful investigation, was distinctly traceable to the supply of milk from a certain dairy. It was found that the proprietor of this establishment had died of typhoid fever, and that other indications of its presence were appreciable.

It is well known that impure water is the chief vehicle for the transmission and communication of this disease, but there was no reason to suppose that the milk had been diluted with water; and it is now thought that the prime cause of the introduction of the poison germs was due to the fact that the milk-pans were washed in infected water.—19 *A*, *October* 23, 1873, 199.

HYPODERMIC INJECTION OF CHLORAL.

An operation was lately performed for the removal of the calcaneum, at the hospital in Bordeaux, in which anæsthesia was produced by injecting 22 grammes of a solution of chloral—one part to three of water—by a capillary puncture into one of the radial veins. At the end of ten minutes the anæsthesia was complete, the patient falling into a profound sleep; and although the operation lasted twenty minutes, and was extremely painful, the subject slept during the whole time. He was roused by the passage of a rapidly intermitting electric current between the left side of the neck and the epigastrium.—12 *B*, *May* 30, 1874, 466.

REMEDIAL ACTION OF THE AILANTUS.

The ailantus, as an ornamental and shade tree, has of late years gone into disrepute on account of the offensive effluvi-

um of its male blossoms, and its planting in Washington was positively forbidden by an Act of Congress—at least an appropriation for the District of Columbia, made some years ago, was granted upon the condition that no ailantus trees should thereafter be planted in the City of Washington. The tree is, however, one of very great value as a timber tree, and is highly recommended for growth upon the Western prairies, as its development is extremely rapid, and the wood is equal to chestnut for mechanical purposes. It is one of the largest trees known, being said to attain a height of 300 feet in China. Very little attention has been directed to its medicinal virtues; but according to Dr. Robert, of the French naval fleet in the waters of China and Japan, the bark of the root, in the form of a powder, is more efficient in the treatment of dysentery than ipecac, calomel, astringents, opiates, etc. For this purpose, one part of the bark of the root is cut into very fine pieces and pounded up in a mortar, to which one and a half parts of warm water are added. The whole is to be allowed to stand for a sufficient time to soften the bark, and is then strained through a piece of linen. The infusion is administered in doses of a tablespoonful, morning and evening, either pure or in a cup of tea. This is to be continued for three days under a very strict dietary regimen. After that, bread and milk may be given, and subsequently ordinary diet. If at the end of eight days a cure is not effected, the treatment may be renewed. This substance is extremely bitter, and its administration frequently produces nausea. In Dr. Robert's experience, a complete cure was almost always brought about within eight days; in only one instance was it necessary to renew the application.—11 *B*, *March* 15, 1874, 233.

CAUSE AND PREVENTION OF DAMP FEET.

According to Orlowsky, of St. Petersburg, close observation shows that the absorption of moisture by the soles of shoes is mainly due to the alternate expansion and contraction of the pores of the leather, under the alternate pressure and removal of pressure in walking, the water being both sucked up and forced up. The moisture admitted through other parts of the shoe is regarded as trifling in comparison, and as readily removed by transpiration. The cause of the

failure of the numerous devices to remedy this, he considers, has been the want of proper attention to the construction of the sole, and the fastening of it directly to the upper, when rubber was employed, thus checking the transpiration of the moisture of the sole of the foot, and rendering it cold in winter and uncomfortable in summer. Regarding rubber as the most suitable material, he claims to have avoided the defects of all previous plans for using it by fastening a gum sole on to a very thin, not too strongly arched, shoe sole, by means of a peculiar cement, and drying it for an hour. Specimens were exhibited at the Vienna Exposition.—9 *C*, *December*, 1873, 180.

CONTAMINATION OF CRUSHED SUGAR BY LEAD.

Cases of poisoning are said to have been caused by particles of lead accompanying the finer portions of sugar which has been broken on a lead block, and which are usually mixed with crushed sugar, or are employed in the manufacture of preserves. The Saxon government has prohibited the use of lead in this connection.—8 *C*, *December* 25, 1873, 436.

NON-POISONOUS CHARACTER OF PURE CORALLINE.

Shortly after the discovery of coralline, one of the new aniline dyes, attention was called to certain cases of poisoning resulting from wearing stockings and other garments which had been colored by it, and a strong prejudice arose against its use. This led to various investigations to determine the facts in the case, and, among others, one by Professor Tabourin, of the Veterinary School of Lyons, whose report is published in *The Annals of the Agricultural Society* of that city. In this he comes to the conclusion that pure coralline, as usually furnished in commerce, is a substance entirely harmless, and that its employment in dyeing and painting may be continued with perfect safety, provided that it be fixed upon textile fibre and upon tissues by the aid of substances destitute of poisonous properties.—*Annals Soc. Agric.*, *Hist. Nat.*, *etc.*, *Lyons*, 1873, III., 254.

FILTER FOR REMOVING ORGANIC IMPURITIES FROM WATER.

A very efficient and serviceable arrangement for removing organic and other impurities from drinking water is that de-

vised by Professor G. Bischof, of Glasgow, which consists essentially in filtering the water through spongy iron and pounded limestone. The iron is placed in the upper chamber of an earthenware filter, and powdered limestone is arranged in a separate layer below. The iron is procured in a powdery, spongy state by the reduction of an ore without fusion, after the extraction of sulphur and copper by heat. It removes all albuminoid and nitrogenized compounds, and also all bad contaminations from the water; and a trace of iron taken up by the water is separated by its subsequent passage through the limestone. It is stated that one charge of the material, costing one shilling, is sufficient for the filtering of ten gallons per day for a period of two hundred days. —21 *A*, *August* 15, 1873, 755.

THE PHYSIOLOGICAL ACTION OF OZONE.

Owing to the important influence which, according to some physicists, even the smallest trace of ozone in the atmosphere exercises upon the health of human beings, a special interest attaches to the researches recently published, by Mr. Dewar and Dr. M'Kendrick, on the physiological action of ozone, when contained in much larger percentages than ordinarily happens in nature. Upon breathing an atmosphere of ozonized air—that is to say, air highly charged with ozone—the authors experienced the following effects: a suffocating feeling in the chest, a tendency to breathe slowly, irritation of the fauces and glottis, a tingling of the skin of the face, and a feebler pulse. The inhalation was continued for eight minutes, when they were obliged to desist; and the experiment was followed by a violent irritating cough and sneezing, and for five or six hours thereafter by a sensation of rawness in the throat and air-passages. Experiments were made on warm and cold blooded animals, and on the separate individual living tissues of the body. Among the results we note the following, in addition to the phenomena above mentioned, which appear to have been very generally experienced. The blood is found after death to be in a venous condition, both in cases of death in an atmosphere of ozonized air and in ozonized oxygen. The inhalation of an ozonized atmosphere is followed by a lowering of the temperature of the body to the extent of ten or twelve degrees.

The inhalation of ozone does not exercise any appreciable action on the capillary circulation. The contractility and work power of the muscles of the frog were found to be unaffected by the action of ozone. The action of this substance on colored and colorless corpuscles of blood resembles that produced by a weak acid. The authors stated that it would be premature at this stage of the inquiry to generalize between physiological action, on the one hand, and the physical and chemical properties of ozone. In general, it seems that the destruction of life by ozone resembles that caused by an atmosphere surcharged with carbonate-acid gas.—12 *A*, 1873, IX., 104.

AUSCULTATION OF THE CHEST FOR BRAIN DISEASE.

Dr. Brown-Séquard has lately insisted upon the importance of frequent auscultation and percussion of the chest in cases of organic disease of the brain. In a communication recently made to the New York Academy of Medicine, he cites cases occurring in animals and man, showing that injuries to the brain will produce emphysema, pneumonia, and diseases of the liver, stomach, and kidneys. Pneumonia is oftener produced when the injury is on the right side of the brain. He referred to one hundred and eighty-eight cases of tubercle, compiled from various sources, in which the origin of the disease was traced to inflammation of the brain, showing it to be not of accidental occurrence. His conclusions are that in animals which have received brain injury, inflammation of the lungs may follow, which may cause death. In man the same effect is shown by actual experiment. Human life may often be saved, after injury to the brain, by early auscultation and percussion.—20 *A*, *August* 30, 1874, 229.

EFFECT OF WATER ON LEAD PIPES.

The question whether there is danger from the use of lead pipes for conducting drinking-water has again been taken up, this time by Belgrand. He calculates the length of lead pipe used for this purpose in Paris, and shows that the water remains in contact with the lead much too short a time to be acted upon. As interesting specimens, he exhibited before the French Academy two pieces of lead pipe, the one laid down in 1670, the other at a period somewhat later. The

inner surfaces of these tubes, notwithstanding that one of them had carried water for two hundred years, were completely intact.

Direct experiments upon the same question have also been carried out by Leblanc, agreeing well with those made by Dumas many years ago. Distilled water was found slightly to attack the lead; while river, spring, and rain water had no appreciable action on the metal.—8 *C, January* 29, 1874.

METHOD OF PURIFYING WATER.

In the preparations for the campaign on the part of Great Britain against the Ashantees, on the Gold Coast of Africa, due precautions were taken in reference to the health of the troops; and as the waters in that region are known to be very bad and deleterious to health, the services of men of science were invoked for suggestions as to the proper mode of purifying them. In an article prepared in this connection by Mr. William Crookes, and published in the *Chemical News*, various methods of purifying water for military purposes are detailed, and the conclusion is reached that the only substance that will be practically available is the sulphate of alumina, which has the power of converting all organized animal matter, living germs, etc., into an insoluble substance like leather, and probably destroying their vitality, at any rate permitting the precipitate to be filtered. This precipitation takes place with great rapidity if fine clay be used with the sulphate, and filtration is then not required, as the clear water can be poured off from the sediment in the course of a quarter of an hour.

Mr. Crookes refers to a mixture of alumina, clay, and charcoal, which is known by the name of A B C compound, and is used by the Native Guano Company of England for the purification of sewage, and with so great success that the most offensive-looking and foul-smelling liquid is, in a quarter of an hour, converted into a bright, clear, inodorous, tasteless water, non-putrescible, and so pure as to allow the most delicate fish to live and thrive in it.

The application of these facts and principles is suggested by Mr. Crookes, the charcoal being omitted, however, and its place supplied with a permanganate; and he gives the following as the elements of a suitable mixture: namely, 1 part of

permanganate of lime, 10 parts of sulphate of alumina, and 30 parts of fine clay. This, when added to the London sewage, in the proportion of 20 parts to 10,000, purifies it completely in a short time. Foul ditch water may be purified with a much less quantity. The mixture can be filtered, instantly yielding a bright filtrate, or it can be allowed to settle for fifteen minutes, when the supernatant water can be poured off equally bright. The cost of this mixture is estimated at a few pence for a hundred gallons of water.—1 *A*, *November* 14, 1873, 243.

STARCH UNFIT FOOD FOR INFANTS.

It is asserted that various experiments have proved that the saliva, as well as the pancreatic juice of newly born animals, does not possess the power of transforming starch into sugar; and it is therefore inferred, with good reason, that any substance containing starch is unfit for food for very young infants, as their physiological condition is probably similar to that of the young of carnivorous animals generally.—5 *A*, *July*, 1873, 320.

CURE FOR DIPHTHERIA.

The ravages of diphtheria have been so extensive in Australia within the last few years that the government offered a large reward for any certain method of cure; and among other responses to this was one by Mr. Greathead, who at first kept his method a secret, but afterward communicated it freely to the public. It is simply the use of sulphuric acid, of which four drops are diluted in three fourths of a tumbler of water to be administered to a grown person, and a smaller dose to children, at intervals not specified. The result is said to be a coagulation of the diphtheritic membrane, and its ready removal by coughing. It is asserted that where the case thus treated has not advanced to a nearly fatal termination the patient recovers in almost every instance.

CURING CROUP WITH BROMINE.

Dr. Schultz, of Prague, has, it is said, been very successful in treating croup with bromine; for which purpose he uses half a gramme of purified bromine and half a gramme of bromide of potassium in ninety parts of water. This is inhaled as

well as applied by means of a brush. Dr. Gottwell also, who has repeated these experiments, thinks that by the use of bromine the diphtheritic membrane loses its consistence, and is readily removed.—1 *B*, *December* 7, 1873, 176.

CROTON-CHLORAL.

Dr. Liebreich, who discovered the anæsthetic properties of chloral-hydrate, has recently recommended the use of another substance, *croton-chloral*. This, which must not be confounded with croton-oil (with which it has nothing to do), is produced by the action of chlorine gas upon aldehyde; and differs outwardly from chloral-hydrate by its crystallizing in glittering tablets, and being less readily soluble in water. When about a dram of the new remedy, dissolved in water, is taken into the stomach, deep sleep ensues, the effect being produced in the course of from fifteen to twenty minutes. The patient experiences complete anæsthesia of the head, the tone of the muscles being unaltered, and the pulse and respiration remaining unchanged for two hours together. Chloral-hydrate, on the contrary, produces a depression of both pulse and respiration.

Dr. Liebreich has administered the croton-chloral to maniacs during the paroxysms of mania, and has found them to be instantly quieted, falling asleep in their chairs, and yet remaining erect in them for hours. If chloral-hydrate had been given, the patients would have dropped to the floor.

In cases of tic-douloureux, where croton-chloral was used, pain ceased before sleep came on; but in this disease the medicine proved to be only a palliative, and not a cure.

The new remedy can be used advantageously where chloral-hydrate is rendered dangerous by heart-disease, or in cases where the latter agent in safe doses fails to produce sleep.

Of course in excessive doses the croton-chloral, like all other narcotics, is poisonous, circulation and respiration being both stopped. But in cases of such poisoning, life may be restored by artificial respiration, and the patient easily saved.—14 *A*, *December* 27, 1873, 510.

CARBOLIC ACID IN CHOLERA.

Much greater use is made in France of carbolic acid and its combinations as articles of the *materia medica* than else-

where, there being apparently but few diseases that are not considered likely to be successfully treated, or at least mitigated in their action, by this remedy. Among other illustrations of this is the hypodermic application of carbolic acid and carbolate of ammonia in the treatment of cholera, and its administration as a prophylactic to the extent of thirty to forty centigrammes a day. In cholerine and confirmed cholera the use of the same liquid is suggested, and, in addition, four to ten subcutaneous injections, each of five grammes of carbolized water of two and a half per cent. strength. These injections are to be kept up until confirmed convalescence, and the internal administration continued until health is restored. When death is imminent, a direct injection of carbolic acid into the veins is recommended.

ANTIDOTE TO CARBOLIC ACID.

It is well known that carbolic acid, even in a tolerable state of dilution, is a violent poison, partly in itself, and partly in the alteration it produces in the tissues; and as it is very much used at the present time for sanitary and other purposes, it is important that a proper antidote should be placed on record. From numerous experiments, Mr. Huseman has proved that the alkalies and alkaline earths are true antidotes to this acid, while the fat oils, glycerine, etc., are entirely without effect. The best antidote, according to this gentleman, is the saccharate of lime, obtained by dissolving sixteen parts of sugar in forty of distilled water, and adding five parts of caustic lime. This should be digested for three days, being stirred from time to time, then filtered, and evaporated to dryness. In cases of poisoning this must be applied in solution, and in large doses, as it is incapable in itself of producing any injurious effect upon the system. —*Chicago Pharmacist, November*, 1873, 331.

PHYSIOLOGY OF DYSPEPSIA.

In a paper upon the nature of dyspepsia, Levin remarks that, according to his experiments, the stomach plays a mechanical part in digestion, and has little to do in the transformation of albuminoid matter into peptones. Nitrogenous substances excite the secretion of the gastric juice. The non-nitrogenous, especially those of a fatty nature, determine the

production of a large quantity of saline serosities, derived by exosmosis from the capillaries of the mucous lining of the stomach. This watery exosmosis, in the opinion of M. Levin, is the cause of dyspepsia in most cases; and the treatment consists in retarding the secretion, for which purpose sulphate of soda, bromide of potassium, and common salt, in small doses of twenty-five to fifty centimeters, may be employed, adding to this a treatment particularly nitrogenous. M. Levin claims to have cured various invalids who have been ill for many years.—15 *C*, VI., 95.

MICROSCOPIC EXAMINATION OF ADULTERATED MILK.

It is stated by Professors Zöller and Rissmüller that while large, medium-sized, and small, round butter globules appear, under the microscope, to fill normal milk, they seem much less crowded, although present of different sizes, in milk diluted with water, according to the degree of dilution. The presence of only medium-sized and small globules indicates that the milk has been skimmed after standing a short time, while milk skimmed after twenty-four hours exhibits separate groups of the small globules only. By standing four hours, under favorable conditions, at a temperature of 64° to 68°, milk parts with forty per cent. of its fatty matter, and as much as eighty-eight per cent. by standing twenty-four hours. The cream in the first case consists chiefly of the larger globules, and is poor in fatty matter; that in the latter case contains also the mass of the medium and small globules, and double the fatty matter. A plate with microscopic illustrations of normal milk, and that skimmed after four and twenty-four hours, is given by the authors.—28 *C*, *July*, 1873, 54.

CURE FOR LUMBAGO.

Dr. Hamon gives an account of a speedy cure of an extremely painful case of lumbago, caused by taking cold when the body was in a state of perspiration. The patient, who called to see him, could scarcely descend from his carriage, on account of the torture which the slightest movement caused him. As the malady seemed to consist of congestion of blood under the surface of the skin, the treatment proposed was the use of a mechanical cupping-glass, by means of which about 2250 grains of blood were taken away in ten minutes.

At the expiration of this time all the pain had disappeared, the patient entered his carriage without any difficulty, and has had no recurrence of the trouble since that time.

Dr. Hamon does not consider this treatment applicable in all cases, but says it is especially indicated where the patient is of full habit, of good constitution, and where such congestion as that referred to is indicated by the symptoms.—1 *B*, *June* 14, 1874, 173.

CURE FOR THE BITE OF POISONOUS SERPENTS.

According to Mericourt, in a communication before the Academy of Medicine, in Paris, the only effective means of counteracting the bite of poisonous serpents, and which should be generally and popularly known, are those which prevent the absorption of the poison immediately after the bite, namely, ligature above the part bitten, suction, lotions, cauterization by means of a white-hot needle, or of a small heap of gunpowder placed on the wound and ignited, or the application of some coagulating caustic. If these means have been neglected, or have been applied tardily and ineffectually, hot alcoholic drinks should be given gradually and in a methodical manner, so that sweating and the elimination of the fluids by the kidneys may be induced as freely as possible. The action of the new sudorific, "Jaborandi," may be tried. If, in consequence of violent vomiting, the introduction of medicine by the stomach be prevented, and any confidence be still retained by the practitioner in the use of ammonia, he may practice its injection, as it is at least harmless.

POISONING WITH ANILINE RED.

A well-established case of poisoning from arsenious aniline red, attended with loss of life, is recorded in a late issue of the *Neues Jahrbuch für Pharmacie.* A whole family was poisoned by eating potatoes that had been cooked in a kettle in which the housekeeper had been dyeing woolen yarn. The kettle had not been cleaned, and the potatoes, boiled in the skin, had acquired an intense red color. Abundant evidences of arsenic were found upon subjecting the potatoes to chemical examination. Another instance, which fortunately did not terminate fatally, occurred some months ago in Jersey City. On this occasion the cause of the trouble was a

pair of mittens dyed a scarlet color with aniline dye. The cases here referred to show the necessity of prudence, and the great desirability of finding some harmless substitute for arsenic in the preparation of these popular colors.

RELATION OF TYPHOID DISEASES TO CRYPTOGAMIC VEGETATION.

The very decided relationship between cases of typhoid fever and the exposure of the patient to sewage emanations has induced the inquiry whether the cause of the disease may not consist in some peculiar form of fungus, developed under certain circumstances, in accordance with the prevailing idea of the relation between microscopic fungi and diseases of various kinds. A writer in the *Gardeners' Chronicle* reports his having discovered in sewers a gelatinous cryptogam, which adheres to bits of sticks, and contains in its mass transparent branched confervoid threads, intermixed with rounded cells, supposed to be the spores.

In the passage of such water through the soil these fungi are strained out, the water becoming quite clear and almost potable. It is suggested by this writer that the way in which the plant acts, if it be the prime agent in producing the disease, is by the entrance of its minute spores into the circulation, causing changes of the blood in the body, something like those produced by yeast in beer, such changes being probably very decided when coming in contact with milk or water containing nitrogenous matter. He concludes with the suggestion that, where the microscope shows evidence of the existence of such confervoid bodies in drinking-water, it should always be rejected as unfit for use except after boiling, and that their absence is a warrant of the potability of the liquid.—14 *A*, *November*, 1873, 348.

CALCIUM IODATE A VALUABLE ANTISEPTIC.

Sonstadt has ascertained that calcium iodate is an admirable antiseptic. Among other results of his experiments, he found that the albumen from fresh eggs treated with 0.05 of a gramme of the iodate, in a bottle, kept sweet six months. Fresh herrings immersed in a similar diluted solution of the iodate remained good four days, and the peculiar rancid flavor of salt herrings could be entirely removed by first soak-

ing in water, to remove the salt, and then immersing in the iodate water. Putrid rain-water became agreeable in taste after twenty-four hours when mixed with one quarter its volume of the iodate water. Rain-water, in which a hundred thousandth of the iodate was dissolved, continued unchanged for a year. Fresh butter covered with the solution kept three weeks, and rancid butter was improved by this treatment.

None of the above articles of food, after being treated as described, gave any indications to the taste of the presence of iodate, which, taken in large doses, even to the amount of one gramme, act like a dose of quinine, and increased the appetite, without, as was believed, producing any injurious effect.

Sonstadt also holds that the iodate will be useful in cases of infectious disease, as, after exposure to foul odors, he detected in himself the premonitory symptoms of a typhoid attack, which entirely disappeared on taking 0.1 gramme of the iodate. It has also been successfully applied for curing toothache caused by the decay of the bone.—21 *A*, *April*, 1874, 394.

ACTION OF COMPRESSED AIR ON MEAT.

According to Bert, meat does not putrefy in compressed air, but merely undergoes a slight change in external appearance. Even when putrefaction has been begun, it is said to be entirely arrested when the substance is introduced into a condensed atmosphere.—18 *A*, *August* 21, 1874, 589.

REPORT OF U. S. MEDICAL DEPARTMENT ON YELLOW FEVER IN 1873.

A report has recently been made by the Surgeon-General of the Army upon yellow fever in the United States in 1873, which shows its origin, progress, and cessation at various Southern points, such as Fort Jefferson, Key West, Fort Barrancas, Camp Dallas, and Mobile.

O. MISCELLANEOUS.

NEW SURVEY OF THE STATE OF MASSACHUSETTS.

The American Academy of Arts and Sciences is agitating the question of the propriety of making a new and more thorough survey of the territory of the State of Massachusetts, in reference to its topographical, zoological, geological, and botanical features. The original survey of this state was begun more than forty years ago, and was the first public survey undertaken in this country, having been subsequently followed by similar ones carried on by other states and by the general government. Massachusetts has the honor not only of originating this series of surveys, but of giving to the country a large proportion of the scientific men who have conducted those of other states. The scarcity of the Massachusetts reports published many years ago has created the necessity for their republication, and suggests the importance of issuing a revised edition rather than a mere reprint. In carrying out this survey the state can take advantage of the provision made by the Federal Congress, by which any state undertaking a topographical survey of its territory is empowered to call upon the United States Coast Survey to make the necessary triangulations, so that the state is at once relieved of a very important part of the work to be done. In making these triangulations, the Coast Survey utilizes the experience of the professors and students in the local colleges. The survey thus becomes a valuable auxiliary to scientific education.

Concerning the value of such a detailed topographical and geological survey there can be but one opinion. The material interests of a country have invariably been shown to be advanced by the development of its hidden resources, and the publication to all the world of the results of the labors of such survey. A map representing the land slopes and the areas of the river bottoms, with the contours of the hillsides, is of the greatest value in guiding plans of public or local improvements, and preventing the waste of capital and labor in unfruitful endeavors. As a single illustration of

this, the results already reached by the appointment of Fish Commissioners may be cited. On a still higher ground the importance of the survey is also urged, since the wide distribution of the reports under the proposed survey will essentially advance the cause of education, by furnishing the citizens of Massachusetts with the means of acquiring a precise and thorough knowledge of nature, as manifested in the familiar objects about them.—*House Document* 266.

CAMBRIDGE ENTOMOLOGICAL CLUB.

A Cambridge Entomological Club was formed on the 9th of January, 1874, by twenty-five gentlemen, residents in and near Cambridge, Massachusetts, having for its object the mutual interchange of discoveries and observations in regard to entomology; and at the fourth monthly meeting, held April 10th, it was determined to undertake the publication of a monthly organ, to be called *Psyche.* This will contain such a part of the proceedings of the society as are considered of general interest, communications, lists of captures, and especially a *bibliographical record*, in which will be given a list of all writings upon entomology published in North America, and all foreign writings upon North American entomology from the beginning of the year 1874. Each number of the work, which is in octavo form, will contain four pages, to be increased as means will permit, and the subscription, for North America, is to be one dollar a year. The editor is Mr. B. Pickman Mann, of Cambridge, Massachusetts. The first number contains an article by Mr. Scudder on the English names for butterflies, and the first part of the bibliographical record.

TWENTY-THIRD ANNUAL MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

A highly successful session of the American Association for the Advancement of Science, being the twenty-third annual meeting, was held at Hartford, Connecticut, commencing August 12th, and continuing until the following Wednesday. The attendance was very full, no less than 220 names having been registered. About 120 new members were elected. The titles of 165 papers were entered, although a small proportion only were actually laid before the association.

The officers elected for the ensuing meeting, which is to take place at Detroit, Michigan, on the second Wednesday in August, 1875, are—president, Julius E. Hilgard; vice-presidents, H. A. Newton, of New Haven, of Section A; J. W. Dawson, of Montreal, of Section B; general secretary, Samuel H. Scudder, of Boston; permanent secretary, F. W. Putnam, of Salem; treasurer, W. S. Vaux, of Philadelphia; secretary of Section A, S. P. Langley, of Alleghany, Pennsylvania; secretary of Section B, N. S. Shaler, of Newport, Kentucky; chairman of the chemical sub-section of Section A, S. W. Johnson, of New Haven.

As might have been expected, very few of the papers presented contained any thing new or important, most of the specialists present having previously announced their discoveries in the scientific journals, without waiting for the slow course of time to bring round the annual meeting of the association.

As usual, the daily papers had their representatives, and copious reports were made and published. By far the most complete of these, however, was that of the New York *Tribune*, which detailed one of its own force to do full justice to the occasion. A very full report, almost anticipating the official volume of proceedings, has already made its appearance as a *Tribune* extra.

SEVENTH ANNUAL REPORT OF THE PEABODY MUSEUM, CAMBRIDGE, MASSACHUSETTS.

The seventh annual report of the Peabody Museum of American Archæology and Ethnology connected with Harvard University, by Professor Jeffreys Wyman, has just been published by the trustees. Like its predecessors, it contains matter of much interest, from the variety of additions in the ethnological field to this rapidly growing establishment, among which special prominence is given to the objects received from the collections by Professor Agassiz during the *Hassler* expedition. The most important of these are sundry crania and ethnological objects collected from the ancient graves or burial-places in Peru by Mr. T. J. Hutchinson, the British consul at Callao, and presented by him to Professor Agassiz.

The next principal source of supply during the year has

been the collection of the Hartt expedition to Brazil, including bows and arrows, earthen vessels, and the like. Specimens are also indicated as received from the Smithsonian Institute, Mr. Henry Coleman, the Boston Society of Natural History, etc.

The report is specially interesting, on account of the discussion of the race characteristics of the ancient Peruvians, as based upon the skulls received from Mr. Hutchinson, and others from Mr. E. G. Squier, and an article on the human remains found in the shell heaps of St. John's River, in Florida. Professor Wyman has been in the habit for many years of spending his winters in Florida in researches in the shell heaps, which have been rewarded during the past winter by numerous interesting discoveries; among others, of human remains, in several localities, of such a character and under such circumstances as to leave no doubt in his mind that they had served as food at the cannibal feasts of the aborigines, since the bones were broken, and treated in precisely the same manner as those of the animals found in similar situations.

The report of the treasurer informs us that the present endowment of the Museum amounts to something over $192,000.

FIRST REPORT OF THE ANDERSON SCHOOL OF NATURAL HISTORY AT PENIKESE.

The first report (that for 1873) upon the organization and progress of the Anderson School of Natural History at Penikese Island has just been made by its trustees, and is occupied by a statement of the circumstances which led to the establishment of the school, and the measures which have since been taken for its success. It will be remembered that, in 1872, Professor Agassiz issued a circular announcing a proposed summer school of natural history at Nantucket, for which the co-operation of eminent naturalists had been secured. This proposition met the eye of Mr. John Anderson, a well-known citizen of New York, and the owner of the small island of Penikese, at the mouth of Buzzard's Bay, which he was in the habit of occupying as his summer residence. This gentleman, through a friend, at once suggested Penikese as a suitable location for the school in question, and offered to present it to Professor Agassiz for that purpose.

In view of the fact that Penikese is nearer the main-land than Nantucket, Professor Agassiz was strongly inclined to accept the offer; although, on account of the absence of sufficient accommodations at the time, he proposed that the school should be conducted at Nantucket, as originally proposed, for the first season.

Mr. Anderson, being desirous that the work should be begun on his island, offered, in response, the sum of $50,000 to meet the cost of starting the establishment; and ultimately a provisional arrangement was made, the school at Nantucket was given up, and the work commenced at Penikese.

The school was opened on the 8th of July, and met with great success, as filling a want that had long been felt; indeed the number of applicants was much greater than could be received. The present of a fine yacht by Mr. Galloupe, of Swampscot, constituted an important addition to the means of research, and by its aid large numbers of marine animals were collected from day to day for the use of the school, in addition to what could be obtained from the shore.

Forty-four persons, of both sexes, availed themselves of the privileges of the school, which consisted in the instructions of Professor Agassiz and his colleagues, and an opportunity of investigating the fauna of the region in company with special students of natural history. The short time allowed for erecting the buildings and putting every thing in working order, after the donation of Mr. Anderson, left so many accommodations unprovided as to interfere somewhat with the comfort and convenience of those who were to live upon the island, but not at all with the enthusiasm of the pupils and the success of the work.

Since the close of the season of 1873 the work of erecting and fitting up the necessary buildings has gone on uninterruptedly, and the establishment opened July 9th with every thing in readiness, and with the means of accommodating a somewhat larger attendance. The school is now under the direction of Mr. Alexander Agassiz, who ranks so deservedly high as a naturalist, and by whom every thing has been and will be done to carry out the wishes of his father.

The report is accompanied by several illustrations, consisting of plans and elevations of the buildings, and a map

of Penikese and of the other islands constituting the group between Buzzard's Bay and Vineyard Sound.

THE PENIKESE SCHOOL.

The public will be much gratified to learn that the lamented death of Professor Agassiz will not prevent the continuation of the school of natural history at Penikese Island, the results of which during the season of 1873 proved to be of so much educational importance. A circular from Mr. Alexander Agassiz, in regard to this, states that two or three times as many persons as can be accommodated have already applied to be received during the coming summer, and that great interest is manifested to prosecute the study of nature under the eminent specialists who have been called to assist in the enterprise.

The necessity of a permanent endowment is very justly set forth by Mr. Agassiz, and especially the importance of means for paying for the services of specialists invited to officiate as instructors. During the first season the services of gentlemen eminent in science were offered without charge, on account of their affection for Professor Agassiz; many of them, indeed, having been his former pupils. But, as Mr. Agassiz remarks, this can not with propriety be counted upon hereafter, and some endowment must be devised out of which to pay such salaries and meet other necessary expenses. He therefore suggests that provision be made by the Legislatures of the several states for the endowment of scholarships, either by the actual payment of the sum of $5000 or an annual grant of $350. The payment of this sum on the part of any state would entitle it to nominate two teachers for admission during the summer to the Penikese school; the selection to be made from among those most apt in natural history. Considering the scarcity of efficient teachers of natural history, and its rising interest and importance as an element in education, this amount is certainly very trifling in comparison with the result to be accomplished.

No charge is made to the students of this school for tuition. It is estimated that the board will amount to between eight and nine dollars per week, and the sum of ten dollars will be assessed for the expense of attendance on rooms and other

incidentals. The situation of the establishment on an island in Buzzard's Bay, at some distance from the regular routes of travel, will necessarily increase the cost of living somewhat, but it is intended that only the actual expense of what is provided shall be called for.

It is announced that this school will open on the 7th of July, and close on the 29th of August. Among the gentlemen mentioned as likely to take part in the instruction are Dr. Packard, Professors Wilder, Morse, Mayer, and Jordan, and Messrs. Putnam, Bickmore, Lyman, and others.

OPENING OF THE ANDERSON SCHOOL AT PENIKESE.

As previously announced, the Anderson School of Natural History at Penikese was opened on the 9th of July for the summer season. The number of students in attendance was large, and found every thing ready for immediate action. A great improvement in the general arrangements over those of last year was noted by the visitors, the buildings having been completed and the dormitories comfortably furnished, while the laboratories were well fitted up for their anticipated functions.

Mr. Alexander Agassiz, who succeeded his father as director, although on the island, was seriously indisposed, and unable to leave his room. Mr. John Anderson, the donor and founder of the establishment, and Mrs. Anderson were present.

Of the corps of lecturers, there were at the opening Messrs. F. W. Putnam, Theodore Lyman, Edward Bicknell, A. M. Mayer, Jordan, and Count Pourtalès. Others who arrived subsequently were Dr. Burt Wilder and Professors Morse and Packard. The number of students in attendance was forty-six, of whom twenty were ladies. They represented sixteen states, and were for the most part persons engaged in teaching, and who desire the better to fit themselves for their duties. The school closed on the 28th of August.

REPORT FOR 1873 OF THE PEABODY ACADEMY OF SCIENCE, SALEM.

The report for 1873 of the trustees of the Peabody Academy of Science has made its appearance, and, like its predecessors,

furnishes evidence of much and successful work in carrying out the objects of the Academy. Mr. F. W. Putnam, the curator, reports numerous additions to the collections, especially in the departments of ichthyology and archæology. A feeling allusion is made to the death of Professor Agassiz, who was ever a constant friend to the establishment. The number of visitors during the year amounted fully to 40,000, the museum being open every day. Dr. Packard, the curator of the Articulata, reports progress in the work of the identification of the collections, in which much assistance has been received from Messrs. Uhler, Hagen, Grote, Crotch, Emerton, and others.

REPORT OF THE MUSEUM OF COMPARATIVE ZOOLOGY FOR 1873.

The annual report of the trustees of the Museum of Comparative Zoology at Cambridge for the year 1873 has just appeared, and gives the usual account of satisfactory work done during that period. They report that, in addition to the regular income of the Museum, which amounts to about $15,000 per annum, the sum of nearly $176,000 has been contributed by various parties to enable the late director, Professor Louis Agassiz, to meet special emergencies in the purchase of specimens, and of maintaining the collections, etc.

With the exhaustion of this sum — as the only reliable support consisted of the regular annual income—it was found necessary to reduce the force very greatly; and on the 1st of April of the present year a large number of the former employés were dismissed, a few being retained to maintain the different departments in a state of efficiency.

Due acknowledgments are made to the gentlemen connected with the Museum for valuable services rendered, as also to the contributors who have added so largely to the number of specimens.

The most important of the additions are those from the *Hassler* expedition, covering as they do all branches of zoology. Next to these are mentioned the very complete series of marine animals from the Mauritius, presented by Colonel Nicholas Pike, the late consul to that island. Extensive donations of Asiatic insects were received from the Rev. M. M. Carleton, and of North American coleoptera from Dr. Lewis,

etc. The most important purchase of the year was that of the collection of fossil crinoids gathered by Mr. Charles Wachmuth.

The death of Professor Agassiz is adverted to in appropriate terms; and Mr. Alexander Agassiz, his son and successor, announces his intention, in behalf of the trustees, of carrying out the views of the founder as fully as practicable.

BULLETIN OF THE MUSEUM OF COMPARATIVE ZOOLOGY.

The tenth number of Vol. III. of the *Bulletin* of the Museum of Comparative Zoology consists of an article on the *Ophiuridæ* and *Astrophytidæ*, old and new, by Theodore Lyman, in continuation and rectification of previous memoirs on the same subject. Many new species are indicated, principally from the Philippine Islands, where they were collected by Dr. Semper, from whom they passed into the possession of the Museum of Comparative Zoology. The memoir is illustrated by seven plates, showing the anatomy of the *Ophiuridæ*, the growth of spines, hooks, and stumps, the formation of armed spines, etc., and the characters of the new species.

CATALOGUES OF THE MUSEUM OF COMPARATIVE ZOOLOGY.

The series of illustrated catalogues of the Museum of Comparative Zoology at Cambridge has recently been enriched by two important additions. The first (or No. 7) consists of Part IV. of a revision of the echini, by Mr. Alexander Agassiz, completing a volume of 762 pages and 94 plates. It is by far the most elaborate work of the kind that has appeared under the auspices of the Museum, and at the same time the most important, in view of the thorough revision that is given to the recent species, the result of a personal inspection of almost every type.

The present part is occupied principally by a study of the structure and embryology of the echini, to which belong seventeen plates issued with Part III.

No. 8 is composed of the first edition of the zoological results of the *Hassler* expedition, and embraces the study of the echini, crinoids, and corals by Messrs. Alexander Agassiz and L. F. Pourtalès. This is accompanied by ten plates in the text. Some of these species have already appeared in the *Bulletin* of the Museum of Comparative Zoology, the

most interesting novelty being an account of a new species of *Rhizocrinus Rawsonii*, by Count Pourtalès. This is closely allied to *R. Loffodensis*, which extends from Florida to the Loffoden Islands, but is larger, and has several important distinctive characteristics.

ANNUAL MEETING OF THE TRUSTEES OF THE MUSEUM OF COMPARATIVE ZOOLOGY.

At the annual meeting of the trustees of the Museum of Comparative Zoology, held in January, a committee reported that to carry out the plan inaugurated by Professor Agassiz a considerably larger endowment will be necessary, and that the funds now on hand are not sufficient to conduct operations on the present scale later than the 1st of April, after which, unless an additional permanent income of $15,000 can be secured, it will be necessary to greatly reduce the scale of work: $30,000 per annum is estimated as being the least sum on which the establishment can be maintained on a satisfactory scale. Efforts are now being made to secure an endowment of $300,000, of which about $65,000 had been contributed at a recent date.

REPORT OF THE BUSSEY INSTITUTION.

A valuable contribution to scientific agriculture has been furnished in the initial number of the *Bulletin* of the Bussey Institution, a school of agriculture and horticulture, near Boston, connected with Harvard University, under trusts created by the will of Benjamin Bussey, of Roxbury, in 1835. When taken possession of in 1861, the property placed in the hands of the trustees of Harvard University had a valuation of $413,290 60, exclusive of the Woodland Hill estate; and in 1870 the actual productive income had risen to $31,000, exclusive of certain annuities chargeable to the property. In this year the school was organized by the appointment of an instructor in farming, and a professor of agricultural chemistry; in subsequent years a professor of horticulture, a professor of applied zoology, an instructor in entomology, a director of the Arnold Arboretum, and a librarian and curator of collections were added.

The Arnold Arboretum is established, in connection with the Bussey Institution, on a gift of $100,000 from the late

James Arnold, of New Bedford, and is intended to include, as far as practicable, all the trees, shrubs, and herbaceous plants, whether indigenous or exotic, which can be raised in the open air at West Roxbury.

In the *Bulletin* of this highly useful institution there are several papers of much value, the first being a report of results obtained on examining some commercial fertilizers, by Professor F. H. Storer, who holds the chair of agricultural chemistry. These consist of sundry superphosphates, bone-meal, bone-blacks, and nitrogenized manures. In this article Professor Storer calls attention to the fact that artificial manures are less likely than the natural to contain eggs or larvæ of injurious insects, referring to a case where some dung from a hen-roost had been found filled with the maggots of the onion-fly, so destructive in many parts of the country.

The second paper contains a record of results obtained on analyzing several samples of American "shorts" and "middlings," with remarks on the average composition of bran, also by Professor Storer, in which he comes to the conclusion that the use of these substances, consisting in great part of the refuse skin of the wheat or grain, may be greatly extended to the benefit of the farmer. It is, however, recommended to begin with a small quantity, and to feed up gradually. The special advantages of these brans is their fitness for supplying the phosphates needed for milch cows and growing animals, and the fact that the manures from them will probably be rich in phosphates. Indeed, Professor Storer thinks that when bran is judiciously used there will be no need of feeding bone-meal to cattle, as is so often done in New England.

Professor D. D. Slade, M.D., of the department of applied zoology, contributes a paper on "The Humane Destruction of Animals," in which, by a series of figures, he shows the proper mode of killing horses, sheep, cattle, dogs, cats, fish, etc. No reference is made by him, however, to a very important apparatus recently introduced in France, with the best results, consisting of a heavily weighted pick, constructed something like a punch for cutting gun-wads, which, with a very slight effort, cuts out a clear plate of bone in the forehead, and penetrates the brain; of course producing instantaneous death, without the necessity of repeated blows.

In a fourth paper, also by Professor Storer, on the agricultural value of the ashes of anthracite, the question whether the ashes of hard coal have any fertilizing power is discussed, with the result of the assurance that no general answer can be made to the question whether they possess any more fertilizing power than glacial sand forming the beds found in the interior of the country, this consisting, as it does, of crushed rock and mineral matters not thoroughly washed out. Frequent experiments showed this sand to possess unexpected fertilizing qualities, whereas nothing of this quality has been detected in the sands of the sea-shore, from which all fertilizing elements would naturally be washed out in time.

THE "TORREY MEMORIAL CABINET."

During his lifetime, Dr. Torrey, the eminent mineralogist and botanist, lately deceased, and for many years United States Assayer in New York, took special pains to collect a cabinet of American ores and minerals, which embraced a large number of very valuable specimens, and was given by him to his son, H. Gray Torrey, who succeeded him in his office.

Mr. Torrey has lately presented this collection to the government, which has authorized the erection of suitable cases in the Assay Office, and bearing the name of the "Torrey Memorial Cabinet." He proposes to extend the collection as far as possible in the same direction, and invites contributions from those who have any specimens of the kind to spare, either as an absolute donation, or as an exchange for such duplicates as he may have it in his power to furnish.

The collection being thus a public one, and placed where it will be of very great service in determining the character of ores brought in for examination, it is to be hoped that the invitation of Mr. Torrey will meet a hearty response, and the collection be greatly enlarged.

"DIRECTORY" OF THE TORREY BOTANICAL CLUB.

The Torrey Botanical Club of New York has issued a "Botanical Directory" for North America and the West Indies, founded upon one of similar character published some years ago by the Essex Institute of Salem. This embraces the names of all persons in America known to the club as inter-

ested in botany, general and special; the names being first printed in alphabetical sequence, and then re-arranged according to the states to which they belong. Such a work as this can not fail to be extremely useful to students, and the one in question will doubtless be eagerly sought after by botanists.

THE BULLETIN OF THE SCIENCE DEPARTMENT OF CORNELL UNIVERSITY.

We welcome the addition to the scientific serials in the United States of the *Bulletin* of the Science Department of Cornell University, of which Nos. 1 and 2 of Vol. I. have just been published. These are well-printed, stout pamphlets, and suitably illustrated. No. 1 consists of a preliminary report of the Morgan expeditions, in the form of a reconnoissance of the Lower Tapajos, by Professor Hartt, and a paper on the Carboniferous Brachiopoda of Itaituba, Rio Tapajos, province of Para, Brazil, by Professor O. A. Derby. By the "Morgan expeditions" is to be understood the series of visits for several successive years made by Professor Hartt, for the purpose of explorations in natural history and ethnology, the expense of which was borne in greater part by Colonel Edwin B. Morgan, of Aurora, New York.

Reports of other researches by these expeditions have also been published in the *Bulletin* of the Buffalo Society of Natural Science, as drawn up by Professor Hartt and Mr. Richard Rathbun.

ISSUE OF "PROCEEDINGS" BY THE NEW YORK LYCEUM OF NATURAL HISTORY.

The Lyceum of Natural History, of the city of New York, one of the oldest and most eminent of American scientific institutions, is mainly known by its *Annals*, which, from the number of important memoirs on general practical science, are standard authority the world over. For some years this society was in a quiescent condition, its resident members being few, or engaged in pursuits which prevented their giving much time to scientific labor.

Since then, however, the tide has turned, and the greatest activity has been manifested. "Proceedings" have been

issued intended to contain all abstracts and briefer communications, and to present an actual record of the operations of the society, and efforts are making to increase the circulation of this series by placing the subscription price at a dollar per annum, in the hope that the public, if not the Lyceum, may be benefited thereby. Subscriptions will be thankfully received by Mr. Robert Dinwiddie, corresponding secretary, No. 113 Water Street, New York.

PUBLISHING FUND OF THE HISTORICAL SOCIETY OF PENNSYLVANIA.

The Historical Society of Pennsylvania is endeavoring to secure a permanent publishing fund, and offers, in return for subscriptions of $25, to supply to each subscriber during his life a copy of every work issued by the society, and to public libraries those published during twenty years to come. The fund already received amounts to $21,000. The money is placed in the hands of trustees, and the interest only used. It is stated that more than nine hundred persons and libraries have, so far, subscribed, and additional names are desired for the sake of increasing the available resources. The society has recently published a translation of the "History of the Swedish Congregations on the Delaware River," by Israel Acrelius. This forms an octavo volume of five hundred pages, and is well illustrated. They will also soon publish an historical map of Pennsylvania, on which will be restored a large amount of aboriginal nomenclature, sites of forts, boundaries of purchases from the Indians, etc.—*Circular.*

REPORT OF THE PHILADELPHIA ACADEMY OF NATURAL SCIENCES.

The report for 1873 of the Academy of Natural Sciences of Philadelphia announces the final completion of the labor upon which Mr. Tryon and his associates have been engaged for several years past; namely, the arranging, labeling, and mounting of a very extensive collection of shells belonging to the Academy. The total number by actual count is 14,161 species, in something less than 100,000 specimens. The collection is stated to be one of the finest extant. The librarian reports 1336 additions in the way of books during the year, of which 299 were volumes. Most of these were obtained

by donation or exchange, a few, however, having been purchased. The announcement of additions to the museum is very meagre compared with some previous years; showing a condition of inactivity, due partly to the want of funds, and still more, perhaps, to the overcrowded state of the building, and the impracticability of properly providing for what is already on hand. Of mammals some ten to fifteen specimens are recorded, six skins of birds, about forty-five jars of reptiles and fishes, fifteen skeletons, and six skulls of vertebrates, with a corresponding proportion of other groups. The largest additions in the zoological department have been of shells, as might be expected from the special activity in this direction on the part of certain members of the Academy.

PHILADELPHIA NATIONAL MUSEUM.

An association has been organized in Philadelphia under the title of the National Museum, with a view of collecting interesting historical records for exhibition at the Centennial of 1876. Among the recent additions is the original charter, with its great seal, of the colony of Pennsylvania in 1701, and signed by William Penn.

REPORT OF THE ZOOLOGICAL SOCIETY OF PHILADELPHIA.

The second annual report of the Board of Managers of the Zoological Society of Philadelphia presents a picture of extraordinary success, by its founders, in the establishment of a first-class zoological garden in that city, and we think it should excite a healthy feeling of emulation on the part of New York in a similar direction. The subject has been agitated for some time in New York, and a commencement made by the collection of a few animals in the Central Park. These animals have furnished a constant source of interest to visitors; but, so far, the number increases slowly, in the absence of means for doing more than to take care of the specimens presented by those who have animals on hand that they can not care for, or those who are induced to forward an occasional contribution from a distance.

At present 616 of the 750 members of the Philadelphia society are annual, paying five dollars on election, and five dollars a year thereafter; ninety-five are life members, who pay fifty dollars on election in lieu of further dues. The Com-

missioners of the Fairmount Park have given thirty-three acres of land to the society for its purposes.

The lot was taken possession of on the 5th of June, 1873, since which one third of the ground has been inclosed with a temporary fence, and the necessary contracts made for the erection of the permanent buildings. The present report brings the history of the society to April of the year 1874. Since that time the society has made an immense stride toward fulfilling its mission, many hundreds of animals having been added; and the garden was opened to visitors on the Fourth of July. Although the entrance fees are placed at a low figure—ten and twenty-five cents—the income has been enormous, amounting, it is understood, to many thousands of dollars within a few months; and there is every reason to believe that when once fairly under way the receipts from this source alone will meet all the expenses. The society has not been organized with a view of making money; and while it will be gratifying to its members not to be called upon for additional contributions, the entire profit will be devoted toward extending the facilities of the establishment.

THE ZOOLOGICAL SOCIETY OF PHILADELPHIA.

The Philadelphia Zoological Society held its annual meeting on the 23d of April. This association, to which have been assigned about thirty-three acres in the great Philadelphia park, and of which it took possession on the 5th of June, 1873, promises soon to constitute an important element in the attractions of Philadelphia. Large numbers of animals have already been brought together, and many more are expected before long. The report of the treasurer was read, to the effect that the gross receipts for the year amounted to about $46,000, of which about six to eight thousand dollars were from income and capital received from life-memberships. The expenditures were $35,109 78, leaving a balance of $10,931 12. A committee reports that the sum of $250,000 will be necessary to place the gardens in such a condition as to give assurance of permanent prosperity, which will enable the society to rival others of the same character elsewhere; and, from the enthusiasm manifested on the subject, it is quite likely that the whole amount will before

long be available. At present the society owns one hundred and thirty-one living quadrupeds, six hundred and seventy-four birds, and eight reptiles. The superintendent of the gardens has been engaged for some time past in collecting animals for the society in Australia, and is now in India for the same purpose, and in the course of the year extensive collections are expected. The species now on hand include a large proportion of the wild animals of North America.

Although the time has been too short to accomplish a great deal in the way of building, yet the grounds have been graded, drains and water-pipes have been introduced, deer-parks constructed; an entrance-lodge, monkey-house, and inclosures for buffaloes built; and there are now three large stone bear-pits in process of construction, and a brick and iron aviary, an eagle aviary, and other arrangements have been completed, or are under way, for the purposes of the society. A building in the grounds is being converted into a restaurant, and much has been done in planting ornamental shrubbery and improving the roadways.

It was proposed at the meeting to open the garden about the 1st of June, or within a year from the beginning of the work upon the grounds. The society is authorized to charge twenty-five cents admission, to aid in defraying the expenses of the garden. It is not a public institution, but an association of private parties, without any expectation of profit, however, from the investment. The principal officers elected for the year were Dr. William Camac, president; Dr. John L. Le Conte, corresponding secretary; William S. Vaux, George W. Childs, and other well-known citizens of Philadelphia, as managers.

It behooves the citizens of New York to be on the alert, if they do not wish to be outstripped by Philadelphia in the favorite project of a first-class zoological garden.

REORGANIZATION OF THE MARYLAND ACADEMY OF SCIENCES.

The Maryland Academy of Sciences, of Baltimore, has recently been reorganized, and promises to assume a prominent position among sister institutions in the United States. The germ of this society was started in the year 1819 in the form of an association for the promotion of science, and was incorporated on the 16th of February, 1862, as "The American

Academy of Science and Literature." In 1834 a building which they had succeeded in obtaining, with the greater part of the library and collections of the society, was destroyed by fire, and all operations were suspended until 1836, when the Academy was again revived. The first and only volume of "Transactions" was published in 1837. The Academy was dissolved in 1844, and the books and collections were distributed among its members.

On the 7th of May, 1855, the Maryland Historical Society established a Committee on Natural History, and in 1836 the American Academy was again organized by the adoption of a constitution, and the election of Mr. Tyson as president. On the 15th of March, 1867, an act of incorporation was obtained, under the title of "The Maryland Academy of Sciences." In 1873 the Academy obtained the lease of a lot of ground on Mulberry Street from the University of Maryland, on which is now being erected a commodious building for a museum and hall. The meetings of the Academy are now held regularly, and many interesting communications are presented from time to time, together with numerous specimens of natural history and ethnology, as well as rare and valuable scientific publications. The present president is Professor Philip R. Uhler; Rev. John G. Morris is vice-president, and the Rev. Dr. Edwin A. Dalrymple corresponding secretary.

BOTANICAL CONSERVATORY OF THE MARYLAND ACADEMY OF SCIENCES.

The Maryland Academy of Sciences proposes to establish a botanical conservatory at Druid Hill Park as soon as the sum of $50,000 can be obtained for the purpose. One of the members, now on a visit to Europe, has been paying attention to the selection of a suitable model for imitation.

SOUTHERN HISTORICAL SOCIETY.

A society has been started in the South, under the name of the Southern Historical Society, having special reference to securing materials toward a history of the events of the late war, all printed matter procurable having been brought together for this purpose, while a vast amount of manuscript has also been received. One gentleman has furnished a his-

tory of the army corps of Northern Virginia, of one thousand pages, while General S. D. Lee has supplied his order-books of the Army of Tennessee. A contract has been made with Trumbull Brothers, of Baltimore, to make the *Southern Magazine* the organ of the society, and they are to publish twenty pages monthly free of cost.

ANNUAL REPORT OF THE LIBRARY OF CONGRESS.

The annual report of the Library of Congress presents a gratifying picture of the growth of this great national establishment, an enumeration on the 1st of December, 1873, exhibiting an aggregate of 258,752 volumes, with about 48,000 pamphlets. The increase during the year amounted to 12,407 books and 5436 pamphlets. The principal sources of supply were by purchase, by copyright, and by deposits from the Smithsonian Institution.

Shortly after the fire which did so much damage to the Smithsonian building an arrangement was made for the transfer of its library to that at the Capitol, and since then the additions, as received, are turned over to that establishment.

Mr. Spofford, the Librarian of Congress, calls attention to the urgent need for additional accommodations for the books, and hopes that measures may be initiated at the present session for the construction of a building sufficiently capacious to permit the proper arrangement of a million volumes.

RECENT PUBLICATIONS OF THE SMITHSONIAN INSTITUTION.

Among the earlier subjects attracting the attention of the Smithsonian Institution was the deficiency of systematic or monographic treatises bearing upon the natural history of the United States, and measures have been taken by it from time to time to remedy this difficulty. At various intervals circulars have been issued by the Institution inviting contributions of collections of a specific character, with the assurance that the material thus obtained would be placed in the hands of eminent specialists, and that their reports would be published, with suitable illustrations, and that to the account of each should be added the list of the localities and donors. This promise has been well realized, and it may safely be said that, with comparatively few exceptions, every complete monograph of any extended division of the animal kingdom

as represented in the United States that has been published within the last twenty years in this country is more or less due to the efforts of this establishment. Among the subjects thus provided for may be mentioned memoirs upon the mammals, the birds, the serpents, the Western fishes; numerous orders of insects, as the Lepidoptera, Coleoptera, Orthoptera, Diptera, Hymenoptera, etc.; the fresh-water and land mollusks, etc.

In botany there have appeared the very costly and elaborate memoirs on the marine algæ, by Dr. Harvey, of Dublin, and on the fresh-water algæ, by Dr. Wood, of Philadelphia. In addition to what has actually been published, others are in an advanced state of preparation, and will soon make their appearance.

Of the series referred to two works have just appeared, one by Mr. George W. Tyron, Jr., of Philadelphia, upon the *Strepomatidæ*, or the American melanians, a group of fresh-water shells occurring in great variety and abundance in American waters. This forms a well-printed volume of nearly five hundred pages, with over eight hundred wood-cuts, representing all the species known to Mr. Tryon at the time of his memoir, and constituting the fourth and final part of the series of the *Land and Fresh-water Shells of North America*. The preceding portions of this were prepared by Mr. Temple Prime, Mr. William G. Binney, Mr. Thomas Bland, and Dr. William Stimpson.

Another recent publication of the Institution is the third part of the Monographs of North American Diptera, by Baron R. Ostensacken and Dr. H. Loew. The fourth part was published several years ago.

ORDNANCE BUREAU REPORT ON SMALL ARMS, ETC.

The report of the Ordnance Bureau for the year 1873 is a valuable document, especially interesting as containing the report of the board of officers appointed to investigate the different patterns of breech-loading muskets and carbines for the military service of the United States. All the various weapons submitted to them are figured in detail. About one hundred different American arms and a number of foreign, including the Chassepot, the needle-gun, the Martine-Henry, and others, were considered. After a very careful

series of experiments, the board came decidedly to the conclusion that the present Springfield gun, of all those examined by them, is really the best adapted to the military service, and they accordingly recommend that this be adopted.

The Elliot breech-loading carbine is recommended for mountain service; and of the several calibres of barrels brought forward, that of 0.45 of an inch was preferred as having more advantages than any other. This was accordingly proposed to the Secretary of War, and approved by him. It was also advised that the barrels of the muskets and carbines be browned.

UNITED STATES DEPARTMENTAL CENTENNIAL BOARD.

The President some time ago directed the heads of the several departments of the government, at Washington, to name for approval an officer whose duty it should be to take charge of every thing connected with the exhibition of articles on the part of the government at the Philadelphia Centennial, and this having been done, the composition of the board has been announced as consisting of Hon. R. W. Tayler, First Comptroller of the Treasury, on the part of the Treasury Department; Colonel S. C. Lyford, for the War Department; Admiral Thornton A. Jenkins, for the Navy; General John Eaton, Jr., for the Interior; Dr. Charles T. M'Donald, for the Post-office Department; William Saunders, for the Department of Agriculture; and Professor S. F. Baird, for the Smithsonian Institution. This board, of which Colonel Lyford has been named as chairman, will probably be intrusted with every thing relating to the exhibition of books, maps and charts, photographs, models of machinery, of military and naval implements, animal, vegetable, and mineral products, and all other objects illustrating the operations and work of the government.

ADDITIONS TO THE NATIONAL HERBARIUM IN 1874.

According to the report of Dr. Vasey, curator of the Herbarium of the Agricultural Department, made to the Commissioner of Agriculture, the most important additions to the collections of that department in 1874 consisted of a large series of plants brought in by the expeditions of Lieutenant Wheeler and Professor Hayden, and transmitted to it by the

Smithsonian Institution, which also furnished a collection of about eight hundred species obtained from Dr. Brende, of Illinois, a collection of plants made by Mr. J. A. Allen on the Yellowstone expedition under General Stanley, and one hundred and six boxes, embracing hundreds of specimens of models of German fungi. Numerous other similar contributions were also received, the most important of which was a series of the mosses of Central Europe, from Mr. Paul Reinsch. Such of these specimens as were wanting in the herbarium of the department have been placed in it, and the remainder constitute a stock set aside for transmission to various establishments in America and Europe, including the leading herbaria.

EUROPEAN SAVANS IN AMERICAN INSTITUTIONS.

Professor Proctor writes to *The Academy* in reference to the policy of the importation by America of European savans as professors in colleges, directors of observatories, etc., and remarks that, at all the chief centres of scientific culture, whether in New England, the Middle, or Western States, he found the general sentiment favorable to such action. He, however, states that while at the college of his adoption such person meets with a warm welcome, and is regarded with special pride (as was the case with Agassiz), elsewhere he is looked upon with jealousy, especially among those best able to weigh the merits of American science. He thinks that it is only among the less well-informed Americans that the qualities of the American leaders in scientific research are undervalued, and this merely because short-comings are imagined which have no real existence. He remarks that the Americans who are best able to judge know that the elaborateness of European scientific training is less effective than their own more practical system; and they consider it unfair that the claims of their best men should be overlooked in favor of strangers.—13 *A*, *August* 1, 1874, 124.

SALE OF DR. TROOST'S CABINET OF MINERALS AND ANTIQUITIES.

The offer for sale of the celebrated cabinet of minerals and antiquities belonging to Dr. Troost, of Nashville, Tennessee, was some time ago announced. We now learn that this

has been purchased, for the sum of $20,000, by the trustees of the Public Library in the city of Louisville. This collection, according to the *American Journal of Science*, contains 13,582 specimens in mineralogy, 2815 organic remains, between 2000 and 3000 rock specimens, besides a considerable collection of modern shells and some archæological specimens. The mineralogical collection is catalogued and minutely described in two large manuscript volumes.—4 *D*, *October*, 1874, 319.

PROPOSED CATALOGUE OF ALL SCIENTIFIC INSTITUTIONS.

Mr. Räuis, assistant secretary of the Royal Academy of Sciences of Brussels, in Belgium, proposes to publish a catalogue of all scientific institutions of whatever character, whether academies, societies, observatories, universities, museums, etc. He desires to obtain information on the following points: 1. Title of the establishment. 2. Date of foundation, creation, etc. 3. Its aim. 4. Titles of the directorate. 5. Seat of the institution, with its exact address. 6. Meetings, prizes, etc. 7. Does the establishment possess a library, archives, museum, cabinet of medals or antiquities, observatories, laboratories? 8. Publications: number and nature (bulletin, reviews, annals, or memoirs); number of volumes published from the commencement; the easiest way of procuring these publications, whether by purchase or exchange. 9. All other useful information not comprised in the preceding questions. We trust that our American establishments will not fail to respond to this request as fully as they can, so that they may be properly represented in the new work. —12 *A*, *September* 17, 1874, 407.

REPORT OF THE ZOOLOGICAL SOCIETY OF LONDON.

The report of the Council of the Zoological Society of London, presented on the 29th of April, 1874, makes a very satisfactory exhibit on the part of this institution, which is almost as well known in America as in Europe. It may be proper to state that the society itself carries on operations precisely like those of ordinary scientific institutions; namely, with officers and members of various grades, holding regular meetings, and publishing reports of its transactions. Its reports, however, are pre-eminent for their scientific zoologic-

al value, and for the extent and beauty of their illustrations, far exceeding in this respect all other serials of the same general character.

There is also a very fine library connected with the society, and there was formerly a museum of prepared specimens. This, however, was transferred to the British Museum. Its zoological gardens, which it still retains, are in Regent's Park, and it is to their present condition that we now take occasion to refer more particularly. A strong encouragement to the establishment of such institutions in our own larger cities may be found in the fact that the receipts during the year amounted to no less than $85,000. In addition to this sum, the receipts from memberships and from the sales of publications, etc., brought the total income up to about $140,000. The number of visitors to the gardens during the year was 713,000. The living animals in the collection on the 1st of December, 1873, consisted of 592 quadrupeds, 1329 birds, and 266 reptiles—total, 2187. The total number of additions to the menagerie during the year amounted to 1414.

ANNUAL RETURN OF THE BRITISH MUSEUM.

The annual return of the British Museum for the financial year ending March 31, 1874, has just been published, and constitutes a document of much interest. We are informed that the number of visitors during the year 1873 amounted to 576,000, an aggregate exceeded only by the number in 1869. The additions to the library amounted to 66,034, of which 33,744 were distinct works. The number of stamps impressed on articles amounted to 216,228.

Among the most important accessions to the library during the year are—first, a perfect copy of the edition of the "Book of Common Prayer," dated 1603, in folio, commonly called the Hampton-Court Book; second, a copy, believed to be unique, of the original edition of Tyndale's "Exposition of the fyrste Epistle of Seynt John," printed abroad, and issued in September, 1531, while Tyndale was at Antwerp; third, a series of early English books, including "England's Helicon," 1600; Robert Chester's poem, "The Annals of Great Brittaine," otherwise entitled "Love's Martyr," 1611; a poem by John Weever on the "Life and Death of Sir John Oldcastle," 1601; besides 225 black-letter English ballads print-

ed in the reigns of Charles II., James II., and William III., forming a valuable addition to the Roxburgh, Bagford, and other collections already in the Museum; fourth, a selection of linguistic books, chiefly from the library of Burgawd des Marets, comprising works in the Basque language, in the patois dialects of France, Spain, and Italy, in Breton and other Celtic languages; fifth, several hundred additional Russian works of great value; sixth, a collection of Indo-Portuguese works, printed at Goa; and, seventh, a large number of Chinese classical and historical works.

The department of manuscripts during the year has been increased by 4415 pieces, of which 3046 are charters. A long list is given in the return of manuscripts of special interest.

The Oriental department has been considerably enriched, especially in the Japanese section.

In the Museum, the additions to the department of antiquities have been extensive: Oriental, Greek, Roman, British, and mediæval, as also the Slade and Christy collections. The Christy collection is especially rich in American antiquities. The accessions to the department of coins and medals amounted to 1605 pieces, the greater part of them mediæval and modern.

In the department of natural history the additions amounted to 30,424, of which 10,644 have been registered in the section of zoology, 18,501 in that of geology, and 12,097 in that of mineralogy. The collections are announced as being in very good condition, although the crowded state of the rooms has prevented the exhibition to the public of any considerable portion. Of the zoological specimens enumerated, 231 are mammals, 4359 birds, 258 reptiles, and 1014 fishes, the remainder being invertebrates. Among these the interesting novelties are too numerous to be mentioned in detail.

The botanical department has also received its share of additions, although their precise number is not indicated.

To the department of prints and drawings there have been added during the year 10,015 pieces, of which about 2000 were presented, and the remainder purchased.

The British Museum, as is well known, receives large appropriations annually, amounting usually to about £120,000, or $600,000, for the purchase of articles, and for the expenses

of their arrangement and preservation. It is the only establishment of its kind in the world that has sufficient funds to purchase whatever is considered of moment, and its growth is consequently steady and rapid. As far as natural history is concerned, the only institution in the United States that could compete with it, as regards the same means of increase, was the Museum of Comparative Zoology at Cambridge, Massachusetts, under Professor Agassiz's direction, and the two museums were not unfrequently simultaneous bidders for some specially desirable article or collection.

NEW PHYSICAL LABORATORY AT OXFORD.

Nature gives a very complete description of the magnificent new physical laboratory of the University of Oxford, England, which was, on the 16th of June, formally presented to the university by the Chancellor. The building has been erected under the superintendence of Professor J. Clerk Maxwell, and contains many evidences of his genius, both in the arrangement of the building and in the apparatus installed therein. The external walls are two feet thick; the foundations being fifteen feet below the surface. The building consists principally of three floors, and is surmounted by a tower fifty-nine feet in height, and contains twenty-six large rooms and numerous apartments, each specially adapted and devoted to experiments in certain departments of physical science. In the magnetic room is placed the great electro-dynamometer of the British Association. The room used for the experiments in heat at present contains an apparatus devised by Professor Maxwell for determining the viscosity of air. The galvanic battery is connected by properly insulated wires with the lecture-room and other portions of the building. The battery which will be employed is, of course, in a room fitted expressly thereto, and is of the style known as Sir William Thomson's tray battery. The lecture-room will afford accommodation for about one hundred and eighty students, the seats for the class rising at an angle of about thirty degrees, and three doors providing sufficient means of egress for the audience. In the room allotted to experiments in electricity of high tension an apparatus contrived by Mr. Latimer Clark has been introduced for the purpose of keeping the air of the room dry. This consists of a heated cop-

per roller, over which passes an endless band of flannel. The roller is heated by means of gas-lights within it, which, being constantly burning, cause every part of the flannel to become hot. The vapor which arises from the heated flannel is carried off by the current of air which supplies the burners inside the roller. The flannel, when thus dried and cooled, passes into the open air of the room, where it again absorbs moisture, and thus the air of the room becomes so dry that the electrical instruments are preserved in a highly insulating condition. The electricity passes from the electrical machine to the table in the lecture-room by insulated wires connected with the prime conductor of the machine. The highest room in the building occupies the upper portion of the tower, its floor being more than fifty feet above the ground. In this room will be placed a Bunsen's water-pump, the water from which will thus have a vertical fall of considerably more than fifty feet. This pump will be used to exhaust a large receiver, from which pipes will communicate with the different rooms; so that, if it be desired to exhaust the air from any vessel, it will only be necessary to connect it with one of these pipes, and *turn on a vacuum.* For a more perfect exhaustion the Spengel or other air-pump can be employed. On the top of the tower will be fixed a wooden mast, carrying a pointed metal rod, for the purpose of collecting atmospheric electricity. Among the apparatus kept in the laboratory may be mentioned the original British Association units of electrical resistance.—12 *A*, X., 140.

TEMPORARY MUSEUM AT THE LATE MEETING OF THE BRITISH ASSOCIATION.

A specially interesting feature of the late meeting of the British Association at Belfast consisted in the establishment of a temporary museum for the exhibition of specimens and apparatus brought before the association at its various sessions. In these were to be found several microscopes for the display of histological preparations and other objects. These articles were all suitably arranged in the anatomical museum of Queen's College, the whole being under the direction of Mr. E. Ray Lankester. A similar plan might be adopted, with great advantage, by the American Association at its future meetings.

FORTY-FOURTH MEETING OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The forty-fourth meeting of the British Association commenced August 20th at Belfast, Ireland, and continued until the 26th. The attendance was about equal to the average, and many interesting papers were presented. The next meeting is to be held at Bristol, beginning on Wednesday, the 25th of August, 1875. Sir John Hawkshaw was elected president; Mr. W. L. Carpenter and Mr. J. H. Clark, local secretaries. The meeting for 1876 is to be in Glasgow.—15 *A*, *August* 29, 1874, 287.

PSYCHOLOGICAL SOCIETY OF GREAT BRITAIN.

London *Nature* contains the announcement of the formation of a Psychological Society of Great Britain, persons desirous of joining it being invited to make application at the office of the *Chemical News*. This society, we presume, is intended to prosecute investigations into the so-called spiritualistic manifestations of which Mr. Crookes makes mention in the January number of the *Quarterly Journal of Science*.

THE MANCHESTER AQUARIUM.

Mr. W. Saville Kent, late superintending naturalist of the Brighton Aquarium, has been appointed to the control of the new aquarium at Manchester. This has been constructed according to Mr. Kent's special ideas on the subject, and promises to be a very decided success. The tank frontage is no less than 750 feet, an amount exceeding that of any aquarium yet constructed.

Some idea of the popularity of exhibitions of this kind, in cities of the size of Manchester, may be gathered from the fact that 10,000 visitors were registered during the first week of the opening.—12 *A*, *June*, 1874, 93.

THE FRENCH MUSEUM OF PHYSICAL AND MECHANICAL SCIENCE.

The establishment of the Conservatoire des Arts et Métiers owes its origin to the illustrious Vaucanson, inspector of factories in the reign of Louis XVI., and this magnificent

educational establishment furnishes some details interesting to those in this country who have to teach the experimental and mechanical sciences. The total number of professors employed by the Conservatoire is fourteen, and the smallest number of lectures given annually by any one professor is forty; the number of persons who attend each lecture is about 240. Originally intended as a collection of machines, instruments, and tools for the instruction of workmen, it was subsequently authorized to extend its sphere to all works of art and science. The system of lectures now carried on began in 1820, in consequence of a royal decree of the previous year. Up to that time instruction had been given only by sight, as it were, by allowing the public almost free access to the immense collection of machines, models, tools, drawings, books, etc. The instruction is free to all, without any condition for admission or any examination. To the honor of the workmen, who form a large majority of the 200,000 attendants on the lectures, it must be said that a more attentive audience can not be found. Never does the slightest disorder arise; and even during the unhappy events attending the recent Franco-German war the Conservatoire was always respected, and underwent no disturbance or invasion.

PRIZE FOR AN ESSAY ON THE HARDNESS AND FRIABILITY OF STEEL.

The Academy of Sciences of Berlin has offered a prize of $200, payable July, 1876, for the best essay recording experiments as to whether changes in the hardness and friability of steel are due to chemical or physical causes, or both. Papers, in German, Latin, English, or French, are to be sent in before March, 1876.—12 *A*, *August* 27, 1874, 344.

MEETING OF THE FRENCH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The French Association for the Advancement of Science held its session for the present year at about the same time as the British Association, and a little later than the corresponding body of savans in the United States, commencing on the 20th of August, and closing on the 27th. It was presided over by Professor Wurtz, and maintained its interest throughout. The meeting was very full, and a large number

of interesting papers were presented, very few, however, by any foreign visitors. As usual on such occasions, numerous excursions were planned and executed having for their object the investigation of geological or ethnological facts, the examination of manufactures, etc. The meeting is to be at Nantes next year, under the presidency of Professor Faye, of the Institute.—8 *B*, *August* 29, 1874, 193.

THE "AMERICAN SOCIETY" OF PARIS.

In 1857 an "American Society" was established in Paris, of which, at present, M. Edward Madier de Montjau is president and M. Emile Bournouf secretary. Those especially interested in starting it were Messrs. Brasseur de Bourbourg, Leon de Rosny, and Alfred Maury. The special objects of the society, according to a circular, are the publication of certain works of Mr. Aubin, having particular reference to Mexican hieroglyphics; the presentation of dictionaries and grammars in the native languages of America; the establishments of chairs of linguistics in Europe, for the service of those who wish to devote themselves especially to the study of America, and furnishing the means to students; and the creation of four museums in the outskirts of Paris, similar to that of Saint Germain, and under the auspices of such municipalities as may encourage the idea; to consist, first, of a Mexican museum; second, a Peruvian and South American museum; third, a museum of the Ethnography of North America; and, fourth, a museum of the Antilles.

The payment of two hundred francs in one sum will constitute any person a founder; while "titularies" are to pay, annually, a subscription of twenty francs; or, once for all, one hundred francs. Members of all classes will receive, without charge, the *Annual* of the society.

At present there are four honorary members, forty-six titular members, and seventeen corresponding members. In the whole series, however, there appears to be but one member from America—namely, Mr. Alexander S. Taylor, of Santa Barbara, California. The society, so far, does not seem to have accomplished much in the way of publications, these consisting of an *Annual*, in two volumes, and a reprint of a letter of Columbus, published in 1865.

A NEW OBSERVATORY.

A new observatory is to be commenced at once in connection with the University of Strasburg, of which Dr. Winnecke will be the director. A refracting telescope of eighteen inches' aperture has been ordered. Another new observatory has been founded at Vienna, which will be provided with the most approved instruments. Littrow, the director of the present institution in that city, publishes an interesting history of the old observatory, and the work which has been done in it during the past hundred years.

MARITIME METEOROLOGY IN GERMANY.

The newly established office for maritime meteorology in Germany has been organized by placing Von Freeden at the head of it. Von Freeden has for the past seven years been director of the Naval Institution at Hamburg; and his long experience and well-known zeal are the best possible assurances of the success of the new and highly important office in which he has been placed.

PRIZE ESSAY OF THE COPENHAGEN ACADEMY OF SCIENCES.

The Academy of Sciences in Copenhagen announces the subject for a prize essay, to be addressed to it through its secretary by the end of October, 1875. It desires a memoir that shall collect in chronological order the various determinations of constant quantities that have been used in spherical and theoretical astronomy from the time of the Ptolemies down to the end of the eighteenth century. It will not be necessary to submit to any critical discussion the intrinsic value of the various constants, but simply to give them in as complete a manner as possible. Special researches respecting the proper motions of stars and parallaxes of stars will be excluded, as also will be those relating to the satellites of the exterior planets, and the elements of orbits of comets. It is desired principally to obtain a complete collection of those numbers that have served as the basis of earlier astronomical researches. The memoir may be written in Latin, French, German, Swedish, or English; and the medal to be awarded will be of gold, of the value of 320 Danish crowns.—*Astron. Nachrichten*, LXXXIV., 47.

GERMAN SOCIETY OF NATURAL HISTORY AND ANTHROPOLOGY IN JAPAN.

A German Society of Natural History and Anthropology for East Asia has completed its first year of existence. Its head-quarters is at Tokio, in Japan, and it numbers fifty-two members—viz., twenty in Tokio, twenty-three in Yokohama, seven in Hiogo, and two in Singapore. The German Minister for Japan is its president, and Dr. Müller vice-president. It has already published a volume of proceedings, containing much interesting matter on the subjects for the furtherance of the study of which it was founded.

INTERNATIONAL EXPOSITION IN CHILE.

An international exposition is to be opened at Santiago, Chile, on the 10th day of September, 1875, and the articles designed for exhibition are to be arranged in four sections. First, natural products in the crude state; second, machinery; third, manufactured articles; fourth, fine arts. A special section is to be devoted to public instruction. Applications for space must reach Santiago by the 1st of January, 1875.

AID TO INVESTIGATIONS IN AGRICULTURAL SCIENCE.

A noteworthy example of aid to scientific investigations has been given by the Royal Agricultural Society of England, in the grant of £100 to Professor De Bary, formerly of the University at Halle, and now of the University of Strasburg, for a new series of investigations upon the nature of potato disease. Professor De Bary was also the recipient of a prize of £100 from Lord Cathcart for investigations upon this subject. His work in this line of research has extended through a number of years, and is of great scientific as well as practical value.

FRENCH ENCOURAGEMENT TO BALLOON ASCENTS.

The French Association for the Advancement of Science has voted to M. De Fonvielle a sum of money, to encourage him to recommence his course of systematic balloon ascents. De Fonvielle intends to study the direction which it is possible to give to a balloon by varying the altitude, in order to

take advantage of several directions of wind. It is not known yet whether he will practice his method for traveling in Europe or in America.—12 *A*, X., 16.

LADY MATHEMATICIANS.

The instances of able mathematicians among ladies are so rare that considerable interest attaches to a letter from Miss Christine Chart, of Oakland, California, recently published in the London, Edinburgh, and Dublin *Philosophical Magazine*, and dealing with a problem which many years since excited some attention in Great Britain. The author of the present solution has submitted it to Professor Sylvester, and very modestly remarks that since the direct solution was, after a long discussion, concluded to be impossible, and not having been able to discover that any person has offered a satisfactory one during the past twenty years, she gives her own, thinking that every mistake cleared up in science is a step toward truth. The problem may be stated thus: In a given triangle two angles are bisected, and the included bisecting lines are found to be equal: required to prove that the angles bisected are also equal. The solution of this problem offered by Miss Chart is acknowledged by Professor Sylvester to be thoroughly sound.—7 *A*, 1874, XLVII., 362.

THE USE OF THE DIVINING-ROD.

Messrs. Pass & Towney, of Bristol, England, communicated to the Naturalists' Society the results of an investigation made by them into the curious superstition attending the use of the divining-rod. As the use of this instrument is by no means obsolete in our own country, it may be worth while to state that Messrs. Pass & Towney were successful in obtaining the attendance of two reputed operators, and both expressed themselves willing and able to find the money which the authors were to conceal. The conjurors maintained that the instrument was available not only in the field but in the mine, and that by it they could detect metal wherever placed. An English shilling being placed under one of a series of objects, such as hats and handkerchiefs, lying on the floor, the master of the divining-rod, or "dowsing fork," guaranteed to find it if there were no disturbing causes. When asked what the latter might be, he said springs of water or

minerals under the house. He was, therefore, first of all to explore the room as a preliminary matter, and ascertain that there were no indications of water nor minerals under the house. The first attempt to discover the location of the hidden coin was successful, but under such circumstances as to show that it was a matter of accident, and the operator refused to repeat the experiment a second time, even for a sovereign. The other diviner, a less expert person, seems to have failed in three successive cases; and when he finally succeeded, the conditions were such as to show the whole of his audience, most of whom were ignorant men and professed converts to the belief in the divining-rod, that the operator was guided by no occult influences, but was merely guessing his way along. It was evident, in fact, that there was no mystery in the whole matter, and that there is as much deception in the use of the divining-rod as was ever practiced by the medicine-men of savage tribes. The use of the forked rod for the purpose of finding minerals, springs, and in fact every possible variety of desiderata, seems to have been handed down to us from the Middle Ages.—*Proc. Bristol Naturalists Soc.*, *New Series*, I., I., 62.

LIFE-SAVING STATIONS ON THE COAST OF THE UNITED STATES.

Among the important enterprises of the United States Government, looking toward the welfare of the nation, not the least valuable is that of the establishment of life-saving stations along the coast, with a view not only of succoring shipwrecked vessels and their crews, but of communicating information to insurance companies and revenue-cutters, and thus securing more efficient aid when needed. A commission has been engaged for some time past in selecting the stations, and it is expected that at no distant day they will be located along the entire coast at intervals of about every twenty-five miles. The present year will witness the completion of that portion of the cordon extending from Cape Hatteras to Sandy Hook; and, in addition to the life-saving force, there will probably be at each station a telegraphic observer, belonging to the Signal Service, having his quarters in the building, and whose duties, in addition to that of reporting accidents or wrecks, will be to receive messages by signal from passing vessels, and to transmit them to any desired point; also

to communicate storm-signals, and to furnish the regular weather dispatches to the Signal-office. The scientific data to be collected by these parties will be of the utmost importance, giving us the means of determining with the greatest accuracy the meteorology of the sea and its coasts, and thereby greatly to improve the storm-signal system.

It will be remembered that observers of the Signal Corps are only assigned to duty after undergoing a rigid training and severe examination at Washington, during which incompetent persons are weeded out, and none employed but those who are prompt, accurate, and intelligent. They are therefore amply qualified to assist in scientific investigations of any kind; and among their labors they will probably render help in determining facts with reference to the fisheries of the coast, in noting the arrival and departure of schools of fish at various points, and thus communicating to the fishermen facts which they would otherwise gather only by accident, if at all. (The government of Norway keeps observers on its coast with special reference to the herring-fishery.) Important information with reference to mackerel, herring, sword-fish, menhaden, or pogees, and other fish of economical importance, will thus be obtained, to the great benefit of the country. The general facts relating to the migration of birds, the occurrence of periodical phenomena of vegetation, and other points will doubtless also be collected by the office.

Of the importance of the Signal Service and its operations generally to the country it is hardly necessary to speak here, as every one is satisfied that the expenditures, however great they may be, are amply warranted, in view of the great importance of the results. The estimate for the present year, covering the entire service of the corps, and including the new branch of the coast life-saving stations, is about $340,000—certainly a very reasonable outlay when we bear in mind that within a short time a cargo of tea worth $100,000 was saved by the timely information communicated from one of the coast stations already established, by summoning to the assistance of the crew relief vessels from a distance so great that they could not otherwise have known of the wreck in season.

AN EXPERIMENT IN SOCIOLOGY.

It is interesting to place on record the success of a recent experiment of what may be called practical sociology, as illustrated in the experience of an association of Friends, formed in Baltimore shortly after the close of the war, for the purpose of advising and assisting impoverished Friends in the Southern States. The immediate object was to afford physical relief, but as the continuance of physical want can only be prevented by removing the cause, the association wisely connected with their beneficence a system of mental, moral, and religious education. Their particular field of operations was in the rural districts of Western North Carolina. In 1867 the association purchased a farm of two hundred acres, at Springfield, between Randolph and Guilford counties, on which they placed, as their superintendent, an experienced and enterprising farmer, and furnished him the means of teaching improved agriculture, by exemplifying its processes, and bringing within the reach of the farmers of that region the necessary facilities for entering upon a career of improvement.

The results of this practically benevolent enterprise have equaled the most sanguine expectations of the association. During the winter following the purchase of the farm many farmers' clubs were organized, nearly four hundred subscribers to various agricultural papers were obtained, and about two tons of clover seed were distributed at cost. In 1871 the superintendent reported that "the leaven is extending from the central farm into very remote regions." Among the evidences of this are noted the greatly increased demand for clover seed. While formerly throughout that region the want of pasture and hay was an insuperable obstacle in the way of keeping stock to any extent, in 1871 ten thousand acres had been successfully seeded with clover. Quantities of the best Peruvian guano had also been introduced. A second proof of advancement was found in the demand for improved agricultural implements, and "it was observed that into whatever neighborhood one of these machines goes, it immediately becomes a silent orator which successfully pleads for the removal of stumps, the filling of hollows, and the under-draining of wet fields." An excellent assortment

of thoroughbred stock is kept on the farm, and has served to improve the stock of the neighborhood. A bone-mill has been erected, driven by the water-power furnished by a small stream running through the farm, and is believed to be the first ever built in North Carolina. The superintendent finds the soil, when properly fertilized with leaves and other handy material, to be as well adapted to fruit-growing as it is to grazing.

In 1872 the association reported that their agricultural enterprise had continued to be favored with growing success. A Superintendent of Education had been added, as a companion to the Superintendent of Agriculture, and he is frequently invited to deliver public addresses in every portion of the state. The educational enterprise has resulted in the establishment of general and permanent schools in eleven adjacent counties; 6000 children have received instruction since 1866. The influence of the operations of the association can be seen for fifty miles around, and 15,000 acres are reported sown with clover. The effect of these efforts in staying the tide of emigration to the West is very apparent, and has already saved to North Carolina hundreds of her best citizens.—*Rep. Ag. Dept.*, 207.

QUETELET'S TABLES OF MORTALITY.

In a recent memoir on Mortality Tables, by Quetelet, after reviewing all the earlier tables of mortality compiled since the days of Halley, for various countries of Europe, he proceeds to the study of the modern tables, in constructing which, as is well known, he has himself taken a prominent part. His object is to obtain a view, not of the individual in particular, but of humanity in its generality. Men act as individuals, and two men equally strong vie with each other with equal chances of success; but if we have a hundred thousand men, equally strong, and battling with the same chances of success against a hundred thousand men of another nation, and if the former be sustained by a sort of unity which makes them act as a single individual, and if the second have not such a sentiment of affinity, we shall immediately see the difference in a very marked manner. The tables of mortality represent many different nations, each nation divided according to the ages and sexes of the individuals,

and we derive from them trustworthy conclusions as to the inherent vitality of the various members of the human race. Only a few of the more striking and interesting statements that may be deduced from the figures given by Quetelet are here reproduced. From birth to the age of five years, out of every 1000 inhabitants, there die, in the respective nations, the numbers given in the first column of the following table:

Country.	Deaths bet. birth and 5 yrs. Total.	Females.	Males.	Attaining 85 yrs. Females.	Males.
Norway	189	90	99	43	42
Sweden	232	109	123	17	9
England	263	121	142	22	17
France	290	138	152	21	16
Belgium	275	132	143	18	13
Netherlands	211	149	162	12	10
Switzerland	274	128	146	10	10
Bavaria, New	285	109	176	10	8
Bavaria, Old	404	189	215		

When we remember that there are born annually more males than females, in the proportion of 105 to 100, while, on the average, there are more adult females than males, it becomes evident that there must be a greater tenacity of life peculiar to the female constitution; a fact remarkably in accordance with the deductions of the Rev. Samuel Haughton, as laid down in his "Animal Mechanics," and one well borne out by the tables of mortality, as is shown by the second and third columns of the preceding table, which give respectively the deaths of male and female infants under five years of age.—*Mem. Acad. Brussels.*

WRECK OF THE WHALER "ARCTIC," OF DUNDEE.

The whaler *Arctic*, of Dundee, in command of Captain Adams, was lost in Davis Strait during the past season, having on board a full cargo of oil. All hands were saved, however.

It may be remembered that after the rescue of the second division of the *Polaris* party by the English whaler the *Ravenscraig*, a portion of the crew was transferred to the *Arctic* and brought into Dundee, receiving on the voyage the utmost kindness and attention from Captain Adams.—12 *A*, *September* 10, 1874, 383.

P. NECROLOGY.

THE following list embraces the principal losses by death during the year 1874 in the ranks of men of science, together with a few names for 1873 which did not appear in the *Record* of that year.

Anderson, Dr. Thomas. Late professor of chemistry in the University of Glasgow. Author of various chemical papers. Born at Glasgow in 1819. Died November 2.

Angström, Professor A. J. An eminent Scandinavian physicist of Sweden. Born at Medelpad, Sweden, in 1814. Died December 22, 1873.

Anstie, Dr. Francis Edmund. An eminent British physiologist and physician. Died December 12, from a dissection wound.

Arnott, Dr. Neil. Born in 1789. Died in March, 1871, in his eighty-sixth year. Well known since 1827 for his "Elements of Physic;" also as the inventor of what is known as "Arnott's Stove," and other important articles of great economical value.

Bachman, Rev. John. One of the oldest American naturalists, associated with Audubon in the preparation of his great work on North American mammals. Claimed by his friends to have been one of the first persons in the United States—if not the first—to practice the art of artificial impregnation of fish. Died February 24, 1874, at Charleston, S.C.

Barclay, Deputy Surgeon-General. Head of the Statistical Branch of the Army Medical Department Head-quarters, Whitehall, England. Died November 13.

Bayan, Ferdinand. Assistant in the School of Mines of Paris, and author of several conchological works. Died September 24, aged twenty-seven.

Beke, Dr. Charles F. Distinguished as a traveler, especially for explorations in Africa in attempting the discovery of the sources of the Nile, for his researches in Eastern Africa, and for his visit to Arabia in 1873 for the purpose of determining the position of the true Mount Sinai, which he contended had been erroneously identified.

Blaney, Dr. J. V. Z. A practicing physician of Chicago, and one of the founders and professors of the Rush Medical College. Much of his time was occupied as an analytical chemist, especially in medico-legal cases. Died in Chicago, December 11, aged fifty-six.

Bloomer, Jr., Hiram G. Curator of the California Academy of Sciences.

Blyth, Mr. Edward. An eminent English zoologist, and prominent as a writer upon the animals of India. Died December 27, 1873, at the age of sixty-two.

Bourcier, M. Jules. A well-known ornithologist; a specialist on the subject of humming-birds.

Brenner, Mr. Richard. A celebrated African traveler. Died at Zanzibar, April 22, 1874.

Burdin, M. An eminent French mathematician and engineer; the first to construct turbine water-wheels; experimented on heated air as a motive-power before Ericsson.

Burkart, Dr. H. J. Author of a work and map of the geology of Mexico. Died at Bonn, November 6, aged seventy-six.

Campbell, Dr. Archibald. For many years in the India Service, and at one time superintendent of the Sanitarium at Dargeeling. A high authority in every thing connected with the condition and resources of India.

Chatelier, M. Inspector-General of Mines of France. Distinguished as an engineer; associated with Sainte-Claude Deville in the manufacture of aluminium from bauxite.

Chevallier, Professor T. Born October 19, 1794. Died November 4, 1873, in the eightieth year of his age. For many years he was professor of mathematics and astronomy in the University of Durham. The first to institute in England regular, continuous observation of the solar spots.

Cipoletti, Professor Domenico. Assistant at the Observatory of Florence; distinguished for his attainments in astronomy.

Crotch, Mr. G. R. Formerly librarian of the University of Cambridge, England; latterly devoting himself to the study of American insects, and performing important service in this connection. Died June 16, 1874, in Philadelphia.

Cruveilhier, M. An eminent French physicist and pathologist, and the author of some valuable works. Born at Limoges in 1791.

De Beaumont, Elie. A French geologist and physicist, and for most of his life connected with the geological survey of France. Born 1792.

De Pontécoulant, Count. An eminent French mathematician, and author of several valuable works. Died July 21, at the age of seventy-six.

Dingler, Dr. E. M. Editor for many years of Dingler's Polytechnic Journal. Died at Augsburg, October 19.

Donati, Professor. Born at Pisa in 1826. Died near Florence, September 20, 1874. Distinguished as an astronomer, and well known as a cultivator of celestial spectroscopy.

Dournaux-Dupéré, M. An explorer. Murdered by the natives while exploring in the Sahara Desert, on the 17th of April, 1874.

Fairbairn, Sir William. A veteran British engineer.

Fox, Sir Charles. A British engineer and architect.

Gavitt, John E. President of the American Bank-note Company. Particularly interested in the microscope, and skillful in its use. Died at Stockbridge, Massachusetts, August 26, 1874, in the fifty-eighth year of his age.

Gay, Mr. Claude. A specialist in botany; the author of a work on the natural and civil history of Chile, occupying twenty volumes of octavo text, with a folio atlas of twenty plates, commenced under the auspices of the Chilian government. Died at Iffendo, France, November 29, 1873, at the age of more than eighty years.

Grant, Professor Robert E. An investigator, teacher, and author in the departments of comparative anatomy and physiology. Born in Edinburgh in 1793. Died in London on the 23d of August, 1874, in his eighty-first year.

Grantham, Mr. John. A British engineer, and largely engaged in constructing steamships. Died July 10.

Grinnell, Mr. Henry. Born in New Bedford, Massachusetts. Died June 20, 1874, at the age of seventy-five. Engaged in the shipping business as a member of the firm of Grinnell, Minturn, & Co., New York; a patron of arctic exploration on many occasions.

Guerin-Méneville, F. E. An eminent French entomologist; founder of the *Magasin de Zoologie* and of the *Revue Zoologique*.

Guizignies, Count du Bus de. Known as an ornithologist, and the author of valuable memoirs on birds, as well as of several articles on fossil crustaceans. Prominent also in the politics of Belgium.

Hancock, Mr. Albany. Born in 1806 at Newcastle-on-Tyne. Eminent as a naturalist, and an author of several important papers, chiefly relating to the mollusca.

Hardick, Mr. Charles. A well-known American mechanical engineer. Died October 15.

Harris, Mr. Stephen. A civil and mining engineer of reputation. Died March 11, 1874, at Pottsville, Pennsylvania.

Harrison, Jr., Mr. Joseph. Known for his mechanical abilities. The inventor of what is known as Harrison's tubular boiler. Born in Philadelphia in 1810. Died in the same city, March 27, 1874.

Hawker, Rev. W. H. A British naturalist, and an active member of the Alpine Club. Died at Petersfield, England, May 26.

Hessenberg, Dr. Friedrich. An accomplished mineralogist and crystallographer. Died at Frankfort, July 8.

Holton, Professor J. E. A botanist. Traveled in Colombia, South America, and the author of a work upon the same. Died at Everett, Massachusetts, January 25, 1874.

Hooker, Lady. Wife of Sir Joseph D. Hooker, of the Royal Kew Gardens. Translator of Decaisne and Le Maout's "Traité général de Botanique." Died November 13.

Jacobi, Dr. Moriz von. Inventor of the galvano-plastic art. Died at St. Petersburg, March 10, 1874, at the age of seventy.

Jardine, Sir William. A well-known British naturalist, and distinguished especially in ornithology, to which he contributed numerous costly publications. Owned a very extensive private cabinet of birds and ornithological library. Died in the Isle of Wight, November 21, aged seventy-four.

Johnson, T. Marr. A British engineer.

Joubert, M. A French explorer. Killed on the 17th of April by some natives while exploring in the Sahara Desert.

Kettlitz, Dr. F. H. A German naturalist, formerly quite prominent, but less conspicuous of later years. Known as the companion of Admiral Lütké in his circumnavigation of the globe, and an author of various zoological and botanical treatises relative to the objects collected, especially in Chile and Russian America. Died at Mainz, April 5, aged seventy-five.

Legros, Dr. Poisoned in the course of some histological researches.

Libessart, M. Léger de. Ex-Consul-General of France in Bolivia, and much interested in the development of the resources of South America.

Linceeum, Dr. Gideon. A physician of Texas, and much interested in natural history, as shown by numerous collections and communications to scientific journals, and an extensive correspondence. Died at Long Point, Texas, November 28, aged eighty-two.

Lowe, Rev. R. T. An eminent naturalist. Lost his life by the wreck of the steamship *Liberia*.

Lühders, Dr. W. A member of the German Arctic Expedition on board the *Hansa*. Died in Western Africa.

Maedler, J. H. An eminent German astronomer; the author of numerous astronomical treatises and memoirs. Died at Hanover, March 14, at the age of eighty.

Maltzan-Peuzlin, von, Baron Heinrich. A traveler, as well as a naturalist and an ethnologist. The author of several important works. Died at Pisa, February 24, 1874, at the age of forty-eight.

Maw, Henry Lister. A British naval officer, and the first Englishman to descend the Amazon from its source to its mouth. Died December 7, aged seventy-three.

Mennier, M. Louis-Francis. A distinguished French philologist. Died at the age of forty-nine.

Miani. An Italian explorer.

Michelet, Mr. Jules. Historian, politician, and author of several works on natural history, especially on "The Bird" and "The Insect." Died in February, 1874, at the age of seventy-six.

Müller, Professor Marcus Joseph. Died at Munich, March 28, 1874, at the age of sixty-five.

Naumann, Professor C. F. A well-known mineralogist. Died at Dresden, December 4, 1873.

Papillon, M. Fernand. A well-known physiologist.

Phillips, Professor John. A veteran scientist of England, best known as a geologist; took a large part in the establishment of the British Association for the Advancement of Science; occupied the chair of geology in King's College, London, and also in the University of Dublin; the author of various important geological works. Died April 24, 1874, at the age of seventy-three.

Pilcher, Dr. Aloys. Formerly head-librarian to the Imperial Library at St. Petersburg, and long connected with the University of Munich. Died June 3, at the age of forty-one.

Plath, Dr. Johann Heinrich. A writer upon Chinese literature and geography. Died at Munich, November 16, aged seventy-three.

Pouchet, Professor F. A. Known by his labors in the direction of spontaneous generation and spontaneous ovulation. Died at Rouen, in July, at the age of seventy-three.

Quetelet, Professor L. An eminent astronomer, physicist, and statistician; founder of the Observatory at Brussels. Died in Brussels, February 16, aged seventy-seven.

Rennie, Sir John. A distinguished British civil engineer. Died September 3, at the age of eighty.

Reuss, Professor A. E. von. A well-known geologist of Vienna.

Rockleder, Dr. Friedrich. Professor of chemistry in the University of Vienna. Died at Vienna, November 6.

Rosa, Mr. Paul. Assistant of Father Secchi at the Roman Observatory, and author of various astronomical treatises. Died July 11, aged forty-nine.

Rousseau, L. P. Assistant naturalist at the Museum of Natural History of Paris, in the department of mollusca and radiates. Died October 14, aged sixty-three.

Schultze, Professor Max. Professor of anatomy at Bonn. Regarded as the first histologist of the day, and author of many important works. Died in January, 1874, at Bonn.

Seebohm, Mr. Louis. One of the photographers of the American transit of Venus expedition. Died at Bahia, July 22.

Shuttleworth, Mr. Robert. A specialist in conchology and botany. Died at Berne, Switzerland.

Slack, Dr. J. H. Well known as one of the leading fish-culturists of the

United States; author of a standard work on practical trout-culture. First Commissioner of Fish and Fisheries for New Jersey. Born in Bordentown in 1834. Died at Bloomsbury, August 27, in the fortieth year of his age.

Smallwood, Dr. Charles. Especially interested in meteorology; for a time in charge of the Montreal Observatory. Died on the 22d of December, 1873, at the age of sixty-six.

Smith, Dr. Edward. A writer on sanitary subjects. Died in London, aged fifty-six.

Sperling, Commander R. M. An officer of the British Navy, and member of the British Ornithologist's Union. Author of several ornithological papers.

Stephens, Mr. Henry. Author of several agricultural works. Died at Edinburgh, at the age of eighty.

Stoliczka, Dr. Best known as a paleontologist and in the department of general geology. Connected with the geological survey of British India at the time of his death.

Teulieres, M. Paulin. A popular author of essays on natural history. Died in Paris, July 11, at the age of seventy.

Tobiesen, Captain Sivert. An enterprising Norwegian arctic voyager; the discoverer of Wiche's Land in 1871. Died April 29, 1873.

Tyrwhit-Drake, Mr. C. F. Connected with the Palestine Exploration Society, and previously a companion of Professor Palmer in his researches on Mount Sinai. Died at Jerusalem, June 23.

Walker, Francis. One of the entomological staff of the British Museum, and a writer on the Diptera.

Way, Mr. Albert. Renowned as an antiquary, and as a writer on historical and ethnological subjects. Born in 1805. Died in March last in London, in his sixty-ninth year.

Winslow, Dr. Forbes. For many years editor of the *Quarterly Journal of Psychological Medicine*, and author of many papers on mental disease.

Wright, Mr. Bryce M. A dealer in specimens of natural history. Died in October.

Wyman, Professor Jeffries. Well known among American naturalists, his researches embracing the departments of comparative anatomy and zoology. Author of an important paper upon the gorilla, and a contributor of many articles to the Proceedings of the Boston Society of Natural History, the Journal of Science, and the Smithsonian Contributions to Knowledge. Born in Chelmsford, Massachusetts, August 11, 1814. Died at Bethlehem, New Hampshire, September 4, in his sixty-first year.

Zetterstedt, Dr. John William. An eminent Swedish entomologist and Professor of Natural History in the University of Lund from 1810 to 1853. Died December 23, aged ninety.

Q. BIBLIOGRAPHY.

SELECT WORKS ON SCIENCE PUBLISHED DURING 1874.

The following classified catalogue is a partial exhibit of the principal scientific works published during the year 1874, especially in the United States. The difficulties attendant upon the preparation of such a bibliography can only be appreciated by those who have attempted similar tasks, the titles given in dealers' catalogues being often inexact. Whenever the original work could be consulted, it has been done; in many cases, however, the volumes could not be obtained in season, and a number of titles have therefore been copied, the resolve to issue the list having been determined upon too late to confirm all. Hereafter, however, no works will be included in this list which have not been examined, and it is proposed to give in connection with at least some of the volumes judgments respecting their value from competent sources, in order that readers may have some criterion for selection.

GENERAL SCIENCE.

GENERAL AND MISCELLANEOUS.

Becker (Bernard H.). Scientific London. An Account of the History and Present Scope of the following Institutions: The Royal Society, The Royal Institution, The Institution of Civil Engineers, The Royal Geographical Society, The Society of Telegraph Engineers, The British Association, The Birkbeck Institute, The Society of Arts, The Government Department of Science and Art, The Statistical Society, The Chemical Society, The Museum of Practical Geology, The London Institution, The Gresham Lectures. London: Henry S. King & Co. 1874. Crown 8vo, 5*s*.

Demoulin (Bordas). Le Cartesianisme du la veritable Renovation des Sciences. Nouvelle edition. Paris, 1874. 8vo, paper.

Galton (Francis). English Men of Science, their Nature and Nurture. London: Macmillan & Co. 1874. 8vo, 8*s*. 6*d*.

Great Britain. *Royal Commission on Scientific Instruction and the Advancement of Science.* Minutes of Evidence, Appendices, and Analysis of Evidence. Vol. II. London. 1874. 8vo. (Parliamentary Blue-book.)

Hunt (Thomas Sterry). Chemical and Geological Essays. Boston: James R. Osgood and Company. 1875. 12mo, $3.

International (The) Scientific Series. New York: D. Appleton & Co. 1873–74.

I. Forms of Water in Clouds, Rain, Rivers, Ice, and Glaciers. By Professor John Tyndall, LL.D., F.R.S.

II. Physics and Politics. By Walter Bagehct.

III. Foods. By Edward Smith, M.D., LL.D., F.R.S.

IV. Mind and Body. The Theories of their Relation. By Alex. Bain, LL.D. 1874.

V. The Study of Sociology. By Herbert Spencer. 1874.

VI. The New Chemistry. By Josiah P. Cooke, Jr. 1874.

VII. On the Conservation of Energy. By Balfour Stewart. With an Appendix, treating of the Vital and Mental Applications of the Doctrine. 1874.

VIII. Animal Locomotion; or, Walking, Swimming, and Flying. By J. B. Pettigrew, M.D. 1874.

IX. Responsibility in Mental Disease. By Henry Maudsley, M.D. 1874.

X. The Science of Law. By Sheldon Amos. 1874.

XI. Animal Mechanism; a Treatise on Terrestrial and Aerial Locomotion. By C. J. Marey. 1874.

Jevons (W. Stanley). The Principles of Science: a Treatise on Logic and Scientific Method. London: Macmillan & Co. 1874. 8vo, 2 vols.

Nature Series. Vols. II.–VII. London: Macmillan & Co. 1873–74. 12mo, cloth.

Forbes (G.): The Transit of Venus.

Lockyer (J. N.): The Spectroscope and its Applications.

Lubbock (Sir J.): On the Origin and Metamorphoses of Insects.

——— On British Wild Flowers, considered in Relation to Insects.

Mivart (St. G.): The Common Frog.

Rodwell (G. J.): The Birth of Chemistry.

Spottiswoode (W.): Polarization of Light.

Owens College, Manchester. Essays and Addresses. By Professors and Lecturers of the Owens College, Manchester. Published in Commemoration of the Opening of the New College Buildings, October 7th, 1873. London: Macmillan & Co. 1874. Thick 8vo, cloth, 14*s*.

Tyndall (John). Address delivered before the British Association, assembled at Belfast: Revised, with Additions by the Author, since the Delivery. New York: D. Appleton & Co. 1874. 12mo, paper, 25 cents.

PERIODICALS.

SOCIETIES (GENERAL).

American Association for the Advancement of Science. Proceedings of the American Association for the Advancement of Science. Twenty-second Meeting, held at Portland, Maine, August, 1873. Salem. 8vo.

SOCIETIES (LOCAL).

Albany Institute. Transactions of the Albany Institute. 8vo.

Boston: American Academy of Arts and Sciences. Memoirs of the American Academy of Arts and Sciences. New Series. Cambridge and Boston. 4to.

——— Proceedings of the American Academy of Arts and Sciences. Cambridge and Boston. 8vo.

Boston Society of Natural History. Memoirs of the Boston Society of Natural History. 4to.

——— Proceedings of the Boston Society of Natural History. 8vo.

Buffalo Society of Natural Sciences. Bulletin of the Buffalo Society of Natural Sciences. 8vo.

Cambridge: Harvard University. Bulletin of the Bussey Institution. [(Jamaica Plain), Boston.]

Minneapolis: Minnesota Academy of Sciences. Bulletin of the Minnesota Academy of Natural Sciences for 1874.

New Haven: Connecticut Academy of Arts and Sciences. Transactions of the Connecticut Academy of Arts and Sciences. 8vo.

New York (Lyceum of Natural History in). Annals of the Lyceum of Natural History in New York. 8vo.

New York: Torrey Botanical Club. Bulletin of the Torrey Botanical Club. 8vo.

Philadelphia (Academy of Natural Sciences of). Journal of the Academy of Natural Sciences of Philadelphia. Second Series. 4to.

——— Proceedings of the Academy of Natural Sciences of Philadelphia. Third Series. 8vo.

Philadelphia: American Philosophical Society. Proceedings of the American Philosophical Society, held at Philadelphia, for Promoting Useful Knowledge. 8vo.

——— Transactions of the American Philosophical Society, held at Philadelphia, for Promoting Useful Knowledge. New Series. 4to.

Philadelphia: Franklin Institute. The Journal of the Franklin Institute, devoted to Science and the Mechanic Arts. Edited by William H. Wahl, Ph.D., assisted by the Committee on Publication. Philadelphia: published by the Franklin Institute at their Hall. 8vo.

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Salem: Essex Institute. Bulletin of the Essex Institute. 8vo.

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Salem: Peabody Academy of Science. Memoirs of the Peabody Academy of Science. 8vo.

——— Sixth Annual Report of the Trustees of the Peabody Academy of Science for the year 1873. Salem. 8vo.

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——— Smithsonian Miscellaneous Collections. 8vo.

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MAGAZINES.

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American Journal of Pharmacy, published by Authority of the Philadelphia College of Pharmacy. Edited by John M. Maisch. 8vo.

American (The) Journal of Science and Arts. Editors and Proprietors, Professors James D. Dana and B. Silliman. [Etc.] New Haven: Editors. 8vo.

American (The) Naturalist, an Illustrated Magazine of Natural History. Edited by A. S. Packard, Jr., and F. W. Putnam. Vol. VIII. Salem, Mass.: Peabody Academy of Science. 8vo, $4 a year.

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Coal (The) and Iron Record. A Weekly Journal devoted to the Coal and Iron Trades. New York. 4to.

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Naturaliste (Le) Canadien. Bulletin de recherches, observations, et découvertes se rapportant à l'histoire naturelle du Canada. Rédacteur: M. l'Abbé Provancher. Québec: Bureau du "Naturaliste Canadien," No. 8 Rue Lamontagne. 8vo.

Nature: A Weekly Illustrated Journal of Science. London and New York: Macmillan & Co. 4to.

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Lockyer (J. Norman). Contributions to Solar Physics: I.—A Popular Account of Inquiries into the Physical Constitution of the Sun, with special reference to Recent Spectroscopic Researches. II.—Communications to the Royal Society of London and the French Academy of Sciences. With Notes. London: Macmillan & Co. 1874. Royal 8vo, with numerous Plates and Illustrations.

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Proctor (Richard A.). Sun-views of the Earth; or, The Seasons Illustrated. Comprising Forty-eight Views of the Earth as supposed to be seen from the Sun at different Hours and Seasons, with Five enlarged Sun-views of England, and a Diagram representing the Earth's daily Motion in her Orbit. London: Longmans & Co. 1874. 4to, 6*s.*

Todhunter (I.). A History of the Mathematical Theories of Attraction and the Figure of the Earth from the time of Newton to that of Laplace. London: Macmillan & Co. 1874. 8vo, 2 vols.

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Johnson (S. J.). Eclipses, Past and Future, with General Hints for Observing the Heavens. London: Parker, 1874. 12mo, cloth, 4s.

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Heath (D. D.). An Elementary Exposition of the Doctrine of Energy. London: Longmans & Co. 1874. 8vo, cloth, 4*s*. 6*d*.

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Goodeve (T. M.). Principles of Mechanics. London: Longmans & Co. 1874. 12mo. (Text-books of Science.)

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THERMOTICS.

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Church (Arthur Herbert). The Laboratory Guide, a Manual of Practical Chemistry for Colleges and Schools, especially arranged for Agricultural Students. London: Van Voorst. 1874. 12mo.

Clowes (Frank). An Elementary Treatise on Practical Chemistry and Qualitative Inorganic Analysis. London, 1874. 12mo.

Cooke (Josiah P., Jr.). The New Chemistry. New York: D. Appleton & Co. 1874. 12mo, $1 50. (International Scientific Series.)

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Faraday (Michael). The Chemical History of a Candle. Edited by Wm. Crookes. With numerous Illustrations. London, 1874. 12mo.

Fresenius (Dr. C. Remigius). Quantitative Chemical Analysis. Sixth edition, reprinted from the Fourth edition. Translated from the Fifth German edition by A. Vacher. London, 1873. 8vo, $7 50.

Miller (William Allen). Elements of Chemistry, Theoretical and Practical. Part II.—Inorganic Chemistry. Revised by Herbert McLeod. Fifth edition, with additions. London: Longmans. 1874. 8vo.

Pink (William W.) and George E. Webster. A Course of Analytical Chemistry (Qualitative and Quantitative), to which is prefixed a brief Treatise upon Modern Chemical Nomenclature and Notation. London: Lockwood & Co. 1874. 12mo.

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Valentin (William G.). A Course of Qualitative Chemical Analyses. Third edition, revised and enlarged. London: J. & A. Churchill, 1874. 8vo, 7*s.* 6*d.*

Waals (Johannes Diderik van der). Over de Continuiteit van den Gas- en vloeistoftoe-stand. Academisch proefschrift. Leiden: A. W. Sijthoff. 1873.

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Dieulafait (Louis). Diamonds and Precious Stones. A Popular Account of Gems. Translated from the French of Louis Dieulafait, by Fanchon Sanford. New York: Scribner, Armstrong, & Co. 1874. 12mo, Cloth, with 126 Illustrations, $2 00.

Selle (——— de). Comparaison et Transformation des Notations Crystallographigues de Levy, Miller, Weiss, Naumann, Dana. Paris, 1874. 4to, Paper.

Westropp (Hodder M.). A Manual of Precious Stones and Antique Gems. London: Sampson Low, Marston, & Co. 1874. Small Post 8vo, Cloth extra, 6*s.*

GENERAL BIOLOGY.

Bastian (H. Charlton). Evolution and the Origin of Life. London: Macmillan & Co. 1874. Crown 8vo, 6*s.* 6*d.*

Beale (Lionel S.). Protoplasm, or Matter and Life. Third edition. London: J. & A. Churchill. 1874. 12mo, 10*s.*

Belt (Thomas). The Naturalist in Nicaragua: a Narrative of a Residence at the Gold Mine of Chontales; Journeys in the Savannahs and For-

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Drysdale (John). The Protoplasmic Theory of Life. London: Baillière, Tyndall, & Cox. 1874.

Ponton (Mungo). The Beginning: its When and its How. London: Longmans, Green, & Co. 1874. 8vo, 18*s*.

Winchell (Alexander). The Doctrine of Evolution: its Data, its Principles, its Speculations, and its Theistic Bearings. New York: Harper & Brothers. 1874. 12mo.

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Foster (Michael). Physiology. London: Macmillan & Co. 1874. (Science Primers.)

Foster (Michael) and Francis M. Balfour. The Elements of Embryology. Part I. London: Macmillan & Co. 1874.

Gillmore (Parker). Prairie and Forest: a Description of the Game of North America, with Personal Adventures in their Pursuit. With Thirty-five Illustrations. New York: Harper & Brothers. 1874. 8vo, $1 50.

Marey (E. J.). Animal Mechanism: a Treatise on Terrestrial and Aerial Locomotion. New York: D. Appleton & Co. 1874. 12mo. (International Scientific Series.)

Newton (Alfred). Zoology. London: Society for Promoting Christian Knowledge. 1874. 16mo, 1*s*. (Manual of Elementary Science.)

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Pettigrew (J. Bell). The Physiology of the Circulation in Plants, in the Lower Animals, and in Man. 150 Illustrations. London: Macmillan & Co. 1874. 8vo, cloth.

Wilson (Andrew). The Student's Guide to Zoology. A Manual of the Principles of Zoological Science. London, 1874. 12mo.

Wolf (Joseph) and Daniel Giraud Elliot. The Life and Habits of Wild Animals. Illustrated from Designs by Joseph Wolf. Engraved by J. W. & Edward Whymper. With descriptive Letter-press by Daniel Giraud Elliot. New York: Harper & Brothers. 1874. 4to, $4.

Wood (J. G.). Out of Doors: a Selection of Original Articles on Practical Natural History. London: Longmans & Co. 1874. 12mo.

MAMMALS.

Bell (Thomas). A History of British Quadrupeds, including the Cetacea. Second edition. London: John Van Voorst. 1874. 8vo.

Gray (J. E.). Hand-list of Seals, Morses, Sea-Lions, and Sea-Bears in the British Museum. Thirty Plates of Skulls. London: Printed by Order of the Trustees of the British Museum. 1874. 8vo, 2 p. l., 44 pp., 30 pls.

Mivart (St. George). Man and Apes, an Exposition of Structural Resemblances and Differences bearing upon Questions of Affinity and Origin. New York: D. Appleton & Co. 1874. 16mo.

Scammon (Charles M.). The Marine Mammals of the North-western Coast of North America, described and illustrated; together with an Account of the American Whale-fishery. San Francisco: John H. Carmany and Company. 1874. 4to, 320, v pp., 27 pls.

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Bancroft (Hubert Howe). The Native Races of the Pacific States of North America. Volume I. Wild Tribes. San Francisco: Author. 1874. 8vo.

Bray (Charles). A Manual of Anthropology or Science of Man, based on Modern Research. London: Longmans & Co. 1874. 8vo, 6s.

Brown (Robert). The Races of Mankind: being a Popular Description of the Characteristics, Manners, and Customs of the Principal Varieties of the Human Family. London: Cassell, Petter, & Galpin. 1874. 8vo.

Carpenter (W. B.). Principles of Mental Physiology. With their Application to the Training and Discipline of the Mind, and the Study of its Morbid Conditions. New York: D. Appleton & Co. 1874. Thick 12mo, $3.

Cleland (John). Animal Physiology: the Structure and Functions of the Human Body. London, 1874. 12mo.

Dawkins (W. Boyd). Cave Hunting, Researches on the Evidence of Caves respecting the Early Inhabitants of Europe. Illustrated by a Colored Plate and Wood-cuts. London: Macmillan and Co. 1874. 8vo, 7s.

Flint (Austin). The Physiology of Man. Designed to Represent the Existing State of Physiological Science as Applied to the Functions of the Human Body. Vol. V. New York: D. Appleton & Co. 1874. 8vo.

Geikie (James). The Great Ice-Age and its Relations to the Antiquity of Man. New York: D. Appleton & Co. 1874. 12mo.

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Saxby (Henry L.). The Birds of Shetland, with Observations on their Habits, Migration, and Occasional Appearance. Edited by his brother, Stephen H. Saxby. Edinburgh, 1874. 8vo, 398 pp., 8 pl.

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Darwin (Charles). The Structure and Distribution of Coral Reefs. Second edition, revised. London: Smith, Elder, & Co. 1874. 12mo.

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Babington (C. C.). Manual of British Botany, containing the Flowering Plants and Ferns arranged according to Natural Orders. Seventh edition; corrected throughout. London: J. Van Voorst. 1874. 8vo.

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GENERAL, DYNAMICAL, AND SPECIAL SUBJECTS.

Dana (James D.). Manual of Geology: treating of the Principles of the Science with special Reference to American Geological History, for the use of Colleges, Academies, and Schools of Science. New York: Ivison, Blakeman, Taylor, & Co. 1874. 12mo.

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Missouri: *State Geological Survey.* Report of the Geological Survey of the State of Missouri, including Field Work of 1873–1874, with 91 Illustrations and an Atlas. Garland C. Brodhead, State Geologist. Printed by the Authority and under the Direction of the Bureau of Geology and Mines. Jefferson City: Regan & Carter, State Printers and Binders. 1874. 8vo. Atlas, 4to.

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